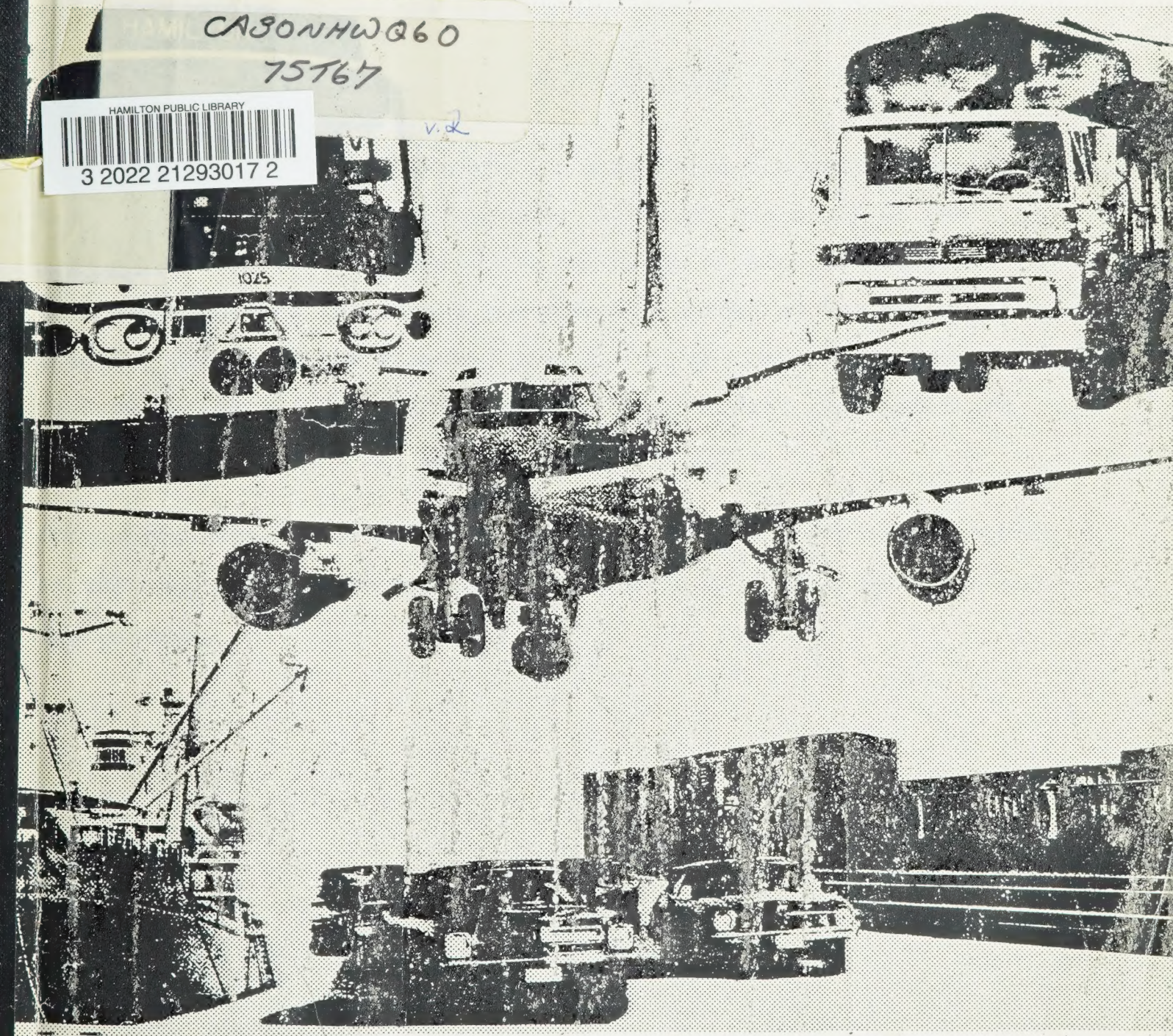
# TRANSPORTATION

## A SUBSTUDY OF THE REGIONAL OFFICIAL PLAN

CA30NHWQ60
75T67
HAMILTON PUBLIC LIBRARY
3 2022 21293017 2



REPORT NUMBER 2

W
4000
.7135
#2
RPL
Oct 75

# AVEL CHARACTERISTICS SURVEY

**EGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH**

**ING AND DEVELOPMENT DEPARTMENT** October 1975

# A C K N O W L E D G E M E N T S

This study was partially funded by a grant from the Ontario Ministry of Transportation and Communication. Although the staff of the Regional Plan Division carried out the major portion of the work, we acknowledge the invaluable assistance provided by the Municipal Planning Branch of the Planning Division of the Ontario Ministry of Transportation and Communications and in particular the assistance of Mr. Ven Chi Ma and Mr. Ken Williams of M.T.C.

Acknowledgement is also made to the System and Data Processing Branch of the City of Hamilton for their assistance in data preparation and key punching.

Digitized by the Internet Archive
in 2023 with funding from
Hamilton Public Library

https://archive.org/details/transportationsu00unse_3

TABLE OF CONTENTS


Page No.

SUMMARY ..... i

CHAPTER I - INTRODUCTION

1.1 BACKGROUND ..... 1
1.2 PURPOSE ..... 3
1.2.1 Output Requirements ..... 3

CHAPTER II - SURVEY DESIGN

2.1 BACKGROUND ..... 7
2.2 STUDY AREA AND INTERNAL ZONING ..... 8
2.3 SAMPLE SELECTION ..... 8
2.4 INTERVIEW PROCEDURES ..... 13
2.4.1 Scheduling ..... 13
2.4.2 Notification to Sample Households ..... 13
2.5 PERSONNEL ..... 14
2.6 CODING ..... 14
2.7 QUALITY CONTROL ..... 17

CHAPTER III - SURVEY OPERATIONS

3.1 WORKLOAD ..... 18
3.2 QUALITY CONTROL PROCEDURES ..... 19
3.3 SUMMARY OF RESULTS ..... 21
3.3.1 Completed Questionnaires ..... 22
3.3.2 Incomplete Questionnaires ..... 22
3.3.3 Rescheduling ..... 23
3.3.4 Survey Response by Municipality ..... 24
3.4 PERSONAL INTERVIEWS ..... 24
3.4.1 Assignment of Personal Interviews ..... 27
3.4.2 Mileage and Interviews Assigned ..... 27
3.4.3 Problems Encountered in Personal Interviews ..... 30

CHAPTER IV - SURVEY ANALYSIS TECHNIQUES

4.1 ANALYSIS METHODOLOGY ..... 31
4.2 PREPARATION OF SURVEY RECORDS ..... 33
4.2.1 Editing Survey Data ..... 33
4.2.2 Merging Trip Records ..... 35
4.2.3 Checks During Merging ..... 36

4.3 ADDITIONS TO TRIP RECORD FILE ..... 39
4.4 FINAL TRIP RECORD FILE ..... 39
4.5 ANALYSIS TECHNIQUES ..... 40
4.5.1 Checks on Survey Accuracy ..... 41
4.5.2 Data Analysis ..... 42

CHAPTER V - SURVEY RESULTS

5.1 REPRESENTATIVENESS OF SURVEY DATA ..... 46
5.2 TRAVEL DATA SUMMARY ..... 52
5.3 TRAVEL BY TIME OF DAY ..... 60
5.4 TRIP PURPOSE SUMMARY ..... 64
5.5 TRIP END SUMMARIES ..... 72
5.5.1 24 Hour Trip End Summary ..... 72
5.5.2 P.M. Peak Hour Trip End Summary ..... 75
5.6 TRAVEL BY MODE ..... 76
5.7 HOME BASED WORK TRIPS ..... 79
5.7.1 Trip Generation Rates ..... 79
5.7.2 Trip Length Frequency ..... 85
5.8 OTHER HOME BASED TRIPS ..... 88
5.8.1 Trip Generation Equations ..... 88
5.8.2 Trip Length Frequency ..... 91
5.9 EXPANSION FACTOR ..... 93
5.10 DIRECTIONAL SPLIT ..... 95
5.11 TRANSIT TRIP CHARACTERISTICS ..... 95

REFERENCES

BIBLIOGRAPHY ..... 98

APPENDICES

APPENDIX A QUESTIONNAIRE FORMS ..... 99
APPENDIX B SURVEY NOTIFICATION ..... 104
APPENDIX C PRESS RELEASE ..... 109
APPENDIX D TARMS TRIP GENERATION EQUATIONS ..... 111

# LIST OF FIGURES


| | | Page No. |
|---|---|---|
| 1.1 | THE TRANSPORTATION SUB STUDY | 2 |
| 1.2 | TRAVEL FORECASTING MODEL VALIDATION AND CALIBRATION | 5 |
| 2.1 | O.D. SURVEY ACTIVITIES | 9 |
| 4.1 | SURVEY ANALYSIS PROCEDURES | 32 |
| 4.2 | TRIP RECORD FORMAT | 37 |
| 5.1 | CAR OWNERSHIP DISTRIBUTION | 53 |
| 5.2 | PERSON TRIPS PER HOUSEHOLD | 56 |
| 5.3 | PERSON TRIPS PER PERSON | 57 |
| 5.4 | TRIP TIME DISTRIBUTION | 62 |
| 5.5 | H.B.W. TRIP TIME DISTRIBUTION | 63 |
| 5.6 | 24 HOUR PERSON TRIP SUMMARY BY PURPOSE | 68 |
| 5.7 | TRAVEL MODE SUMMARY | 77 |
| 5.8 | TRIP LENGTH FREQUENCY DISTRIBUTION H.B.W. | 86 |
| 5.9 | CUMULATIVE TRIP LENGTH FREQUENCY DISTRIBUTION H.B.W. | 87 |
| 5.10 | TRIP LENGTH FREQUENCY DISTRIBUTION H.B.O. | 92 |
| 5.11 | CUMULATIVE TRIP LENGTH FREQUENCY DISTRIBUTION H.B.O. | 94 |

# LIST OF TABLES


| | | Page No. |
|---|---|---|
| 2.1 | DESIRED SAMPLE DISTRIBUTION | 11 |
| 2.2 | SELECTED SAMPLE DISTRIBUTION | 12 |
| 3.1 | TRIP CATEGORY FORM | 21 |
| 3.2 | MONTHLY SUMMARY OF HOME INTERVIEW O.D. SURVEY | 21 |
| 3.3 | SUMMARY OF INCOMPLETE SAMPLES | 23 |
| 3.4 | RESPONSE BY MUNICIPALITY | 25 |
| 3.5 | RESULTS OF PERSONAL INTERVIEWS | 26 |
| 3.6 | INCOMPLETE PERSONAL INTERVIEWS | 26 |
| 3.7 | PERSONAL INTERVIEWS BY WEEK | 29 |
| 3.8 | PERSONAL INTERVIEWS - MILEAGE | 29 |
| 5.1 | TRAVEL SURVEY RECORD SUMMARY | 47 |
| 5.2 | GEOGRAPHIC DISTRIBUTION OF SAMPLE | 47 |
| 5.3 | AGE DISTRIBUTION OF SURVEY SAMPLE | 48 |
| 5.4 | HOUSEHOLD SIZE DISTRIBUTION OF SAMPLE HOUSEHOLDS | 49 |
| 5.5 | HOUSEHOLD SIZE DISTRIBUTION OF SAMPLE POPULATION | 50 |
| 5.6 | EMPLOYMENT DISTRIBUTION BY OCCUPATIONAL CATEGORY | 51 |
| 5.7 | EMPLOYMENT DISTRIBUTION BY INDUSTRY CATEGORY | 51 |
| 5.8 | HOUSEHOLD SIZE VERSUS CAR OWNERSHIP | 54 |
| 5.9 | TRAVEL SURVEY INFORMATION SUMMARY | 55 |
| 5.10 | PERSONS NOT MAKING TRIPS BY AGE CATEGORY | 59 |

LIST OF TABLES


| | | Page No. |
|---|---|---|
| 5.11 | PERSONS WITH DRIVERS LICENCE | 60 |
| 5.12 | PERSON TRIPS BY PURPOSE | 65 |
| 5.13 | TRIP GENERATION SUMMARY - 24 HOUR | 66 |
| 5.14 | TRIP GENERATION SUMMARY - P.M. PEAK HOUR | 67 |
| 5.15 | TRIP PURPOSE COMPARISON WITH 1961 H.A.T.S. STUDY | 72 |
| 5.16 | 24 HOUR - HOME BASED WORK TRIP PRODUCTION RATES | 80 |
| 5.17 | 24 HOUR - HOME BASED WORK TRIP ATTRACTION RATES | 81 |
| 5.18 | P.M. PEAK HOUR - HOME BASED WORK TRIP PRODUCTION RATES | 83 |
| 5.19 | P.M. PEAK HOUR - HOME BASED WORK TRIP ATTRACTION RATES | 83 |
| 5.20 | P.M. PEAK HOUR HOME BASED WORK TRIP GENERATION EQUATIONS | 85 |
| 5.21 | H.B.O. TRIP PRODUCTION RATES | 89 |
| 5.22 | H.B.O. TRIPS - LAND USE AS A TRIP ATTRACTOR | 91 |
| 5.23 | TRANSIT RIDERSHIP | 97 |

# SUMMARY

## 1. PURPOSE OF SURVEY

The purpose of the Home Interview Travel Characteristics Survey was to collect information pertaining to the travel habits of the population of the Regional Municipality of Hamilton-Wentworth and immediate adjacent urban areas. This data is necessary within the analytical framework of the Transportation Substudy of the Official Plan.

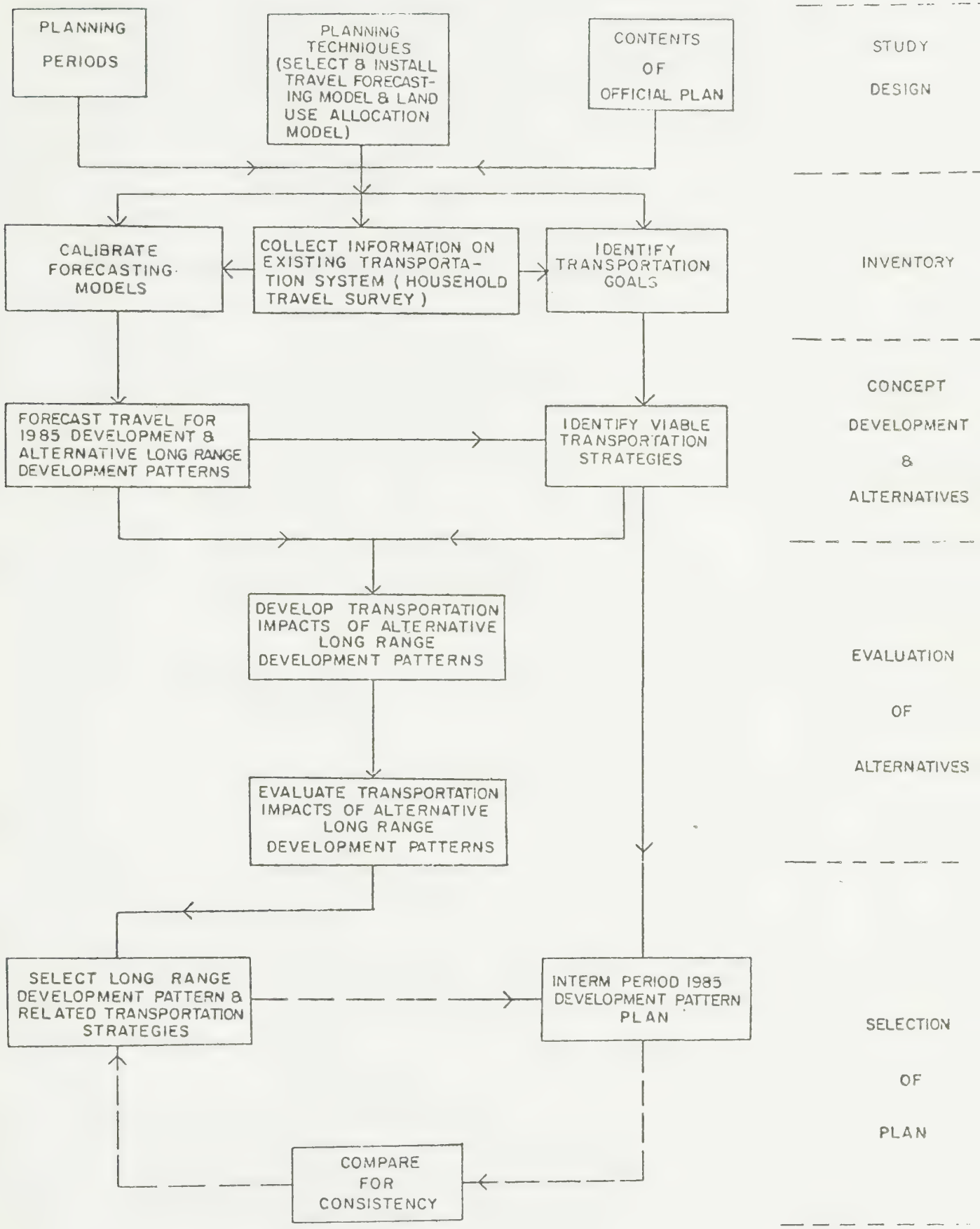
Figure I is a flow diagram of the major activities to be carried ou within the Transportation Substudy. The group of activities class- ified as inventory includes the calibration of travel forecasting models. The models are a set of computerized mathematical equation relating travel demand to development and land use parameters. Det information is required from the survey concerning the travel chara cteristics of persons and households within the Region in order to carry out the calibration process.

## 2. SURVEY DESIGN

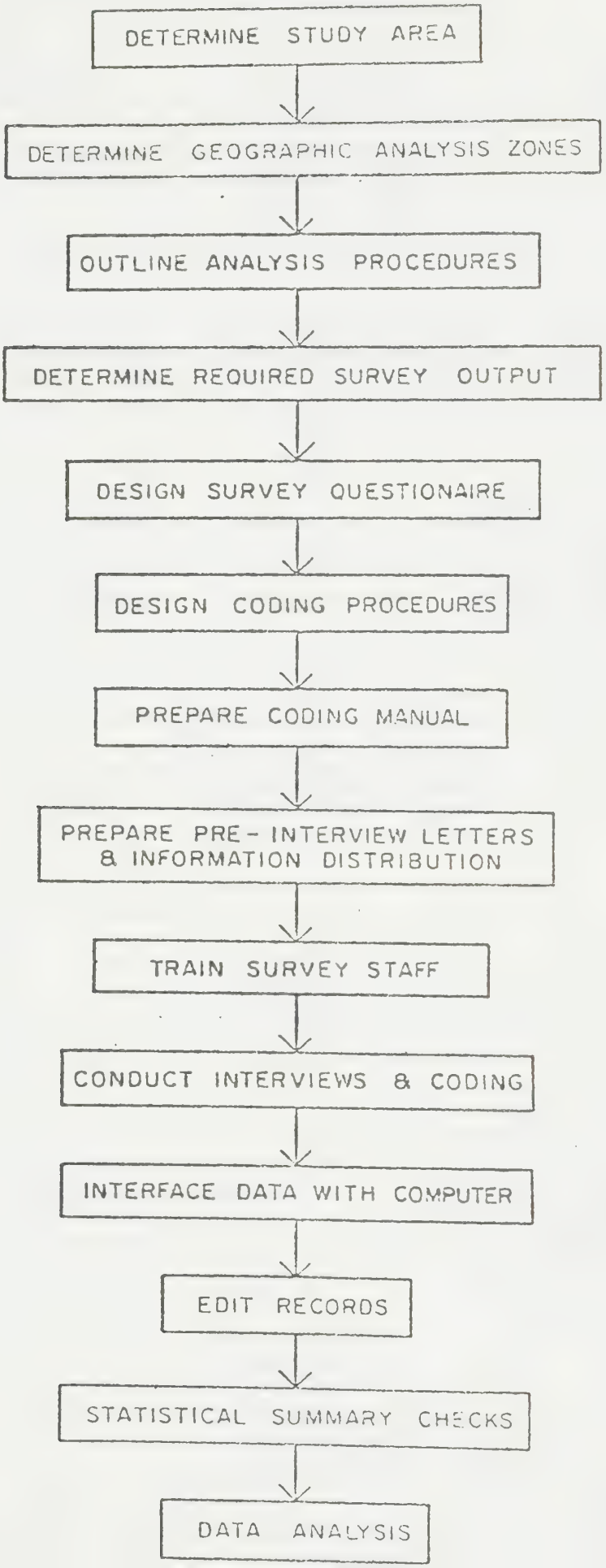
Figure II is a flow diagram of all activities associated directly to the Home Interview Travel Characteristics Survey. The study area was decided on in the design of the Transportation Substudy and includes the Regional Municipality of Hamilton-Wentworth and th city of Burlington. The geographic zones used in the survey for a base of data collection utilized the same boundaries as were devel- oped for the TARMS study. There was some adjustment in the zonal numbering system for this survey.

The survey questionaire was designed to collect only that informati necessary for the validation and calibration of parameters in the traffic forecasting models. The traffic forecast models are design

# FIGURE I: THE TRANSPORTATION SUB-STUDY


PLANNING PERIODS
PLANNING TECHNIQUES (SELECT & INSTALL TRAVEL FORECASTING MODEL & LAND USE ALLOCATION MODEL)
CONTENTS OF OFFICIAL PLAN
STUDY DESIGN
CALIBRATE FORECASTING MODELS
COLLECT INFORMATION ON EXISTING TRANSPORTATION SYSTEM (HOUSEHOLD TRAVEL SURVEY)
IDENTIFY TRANSPORTATION GOALS
INVENTORY
FORECAST TRAVEL FOR 1985 DEVELOPMENT & ALTERNATIVE LONG RANGE DEVELOPMENT PATTERNS
IDENTIFY VIABLE TRANSPORTATION STRATEGIES
CONCEPT DEVELOPMENT & ALTERNATIVES
DEVELOP TRANSPORTATION IMPACTS OF ALTERNATIVE LONG RANGE DEVELOPMENT PATTERNS
EVALUATE TRANSPORTATION IMPACTS OF ALTERNATIVE LONG RANGE DEVELOPMENT PATTERNS
EVALUATION OF ALTERNATIVES
SELECT LONG RANGE DEVELOPMENT PATTERN & RELATED TRANSPORTATION STRATEGIES
INTERM PERIOD 1985 DEVELOPMENT PATTERN PLAN
SELECTION OF PLAN
COMPARE FOR CONSISTENCY

# FIGURE II: O.D. SURVEY ACTIVITIES



to project major travel corridor demands in terms of person trips for P.M. peak hour conditions and require a minimum amount of data on travel habits from each survey sample. The survey was also designed in such a nammer that it required the smallest possible sample of the total study area population.

The survey information was collected using the telephone where possible. A standard survey methodology was utilized collecting information on all trips made by members of the sample household (5 years of age or older) for a 24 hour period. The survey was scheduled to collect the information over a four month period from September to December 1974 with an equal sampling of travel on the five week days.

The survey sample was selected so that it represented a one percent sample of all households in the Study Area. The sample selection was distributed geographically in proportion to the geographic distribution of the total population within the study area. The source of the sample selection was the local assessment files of the municipalities and townships within the study area The selection basis was address, Table 1 shows the number of survey sample households by municipalities at different points in the survey. Telephone numbers for sample households were found by utilizing various telephone directories. All samples for which a telephone number could not be found were scheduled to be interviewed in person.

Each sample household was notified by mail one week previous to a scheduled interview. The notification explained the purpose of the survey, when and how the household would be contacted and the type of questions that would be asked. In addition the survey recieved some planned publicity from local newspapers, radio and television.

TABLE 1

SAMPLE DISTRIBUTION BY MUNICIPALITY

| MUNICIPALITY | NO. OF SAMPLES SELECTED | NO. OF SAMPLES COMPLETED | SAMPLES AFTER EDITING |
|---|---|---|---|
| ANCASTER | 34 | 33 | 32 |
| BURLINGTON | 285 | 247 | 247 |
| DUNDAS | 53 | 51 | 51 |
| FLAMBOROUGH | 68 | 59 | 58 |
| GLANBROOK | 25 | 22 | 19 |
| HAMILTON | 1,084 | 924 | 922 |
| STONEY CREEK | 85 | 74 | 73 |
| TOTAL | 1,634 | 1,410 | 1,402 |

Five temporary staff members were hired to conduct the interviews and to code the information. A permanent staff member coordinated the survey operations and performed quality control checks on the survey data and coding, on a continuing basis.

The information obtained from each sample household was coded in such a manner that it could be analysed with the aid of an electronic computer. The coding of geographic locations utilized existing street indexes developed for Wentworth County and the City of Hamilton.

The survey was very well recieved by the public. Of the 1634 sample households scheduled for interviews 1410 cooperated in completing the questionaires. This gave a completion rate of 86% which was much better than originally anticipated. Of the 224 sample households that did not complete the questionaire only 116 refused with no reason or justification.

The analysis of the survey data was done on the Ministry of Transportation and Communication's computer facilities at Downsview Ontario utilizing computer programs designed specifically for analysing survey data. The staff at M.T.C. were most cooperative in aiding in the survey analysis. The analysis of the data involved some editing and manipulation of the survey information to put it in a usable form. Data summaries were compiled from the survey data to check for biases in the survey sample and other summaries were compiled to provide the information necessary for validating and calibrating the traffic forecasting model.

## SURVEY RESULTS

The final survey data after editing procedures contained records on 1402 households with a total population of 4435 of whom 4133 were 5 years of age or over, and therefore reported their trip making activities There was a total of 10216 distinct survey records containing data on a total of 8768 person trips. A cross reference of the survey data summaries with similar summaries from the 1971 Canada Census for the Hamilton area pointed out only minor biases in the survey sample.

## 1 HOUSEHOLD TRAVEL

According to the survey the average household in the study area has 1.2 automobiles for its use with over 50% of the households having one automobile and 18% of the sample households having zero automobiles. The average household generated 6.25 person trips over a twenty-four hour period on a week day. Thirty-five percent of the sample population over 5 years of age made no trips other than walk trips. Thirteen percent of the sample households generated no trips other than walk trips.

TABLE II

TRAVEL SURVEY INFORMATION SUMMARY

| ITEM | INFORMATION |
|---|---|
| Number of Households | 1,402 |
| H. H. With Zero Autos | 248 |
| H. H. With Zero Trips | 178 |
| Autos | 1,678 |
| Population (Total) | 4,435 |
| Population (5+ YRS) | 4,133 |
| Full Time Employees | 1,790 |
| Licenced Drivers | 2,175 |
| Persons With Zero Trips | 1,446 |
| Total Person Trips | 8,768 |
| Vehicle Driver Trips | 5,074 |
| Transit Trips | 1,024 |
| Persons/H. H. | 2.95 |
| Employees/H. H. | 1.28 |
| Autos/H. H. | 1.20 |
| Person Trips/H. H. | 6.254 |
| Vehicle Trips/H. H. | 3.61 |
| Percent H. H. With Zero Autos | 17.70% |
| Percent H. H. With Zero Trips | 12.70% |
| Labour Participation Rate | 0.40 |
| Autos/Person (Total) | 0.38 |
| Person Trips/Person (Total) | 1.98 |
| Vehicle Trips/Person (Total) | 1.40 |
| Percent Persons Not Making Trips | 34.98% |

Table II gives a general summary of the travel data obtained from the survey.

2 TRAVEL BY TIME OF DAY

Figure III shows the person travel by time of day. The morning peak hour occurs between 8:00 and 9:00 a.m. and the afternoon peak hour occurs between 4:30 and 5:30 p.m. The P.M. peak hour contains approximately 11 percent of the 24 hour person trips and the morning peak hour contains less than 10 percent of the 24 hour travel. Analysis of travel by time of day shows that the shift operations at the industrial and manufacturing plants have little impact on the amount of travel that occurs during the peak hours.

3 TRAVEL BY PURPOSE

Table III gives a summary of person travel by purpose. In the 24 hour period nearly 84 percent of person trips either start or end at the home. In the P.M. peak hour this increased to 86 percent of all trips. Home based work trips account for 32 percent of all person travel that occurrs on an average week day, while it accounts for over 50 percent of all travel occurring in the P.M. peak hour. This suggests that 50 percent of the travel occurring in the peak demand periods is essential work to home or home to work travel and that the other 50 percent is not all essential trips. This data shows that it is important to model all home based travel when simulating travel demand. The survey data shows that home based school trips account for a significant amount of travel but that very few occur during the peak period of travel demand.

# FIGURE III : TRAVEL CHARACTERISTICS SURVEY
## TRIP TIME DISTRIBUTION

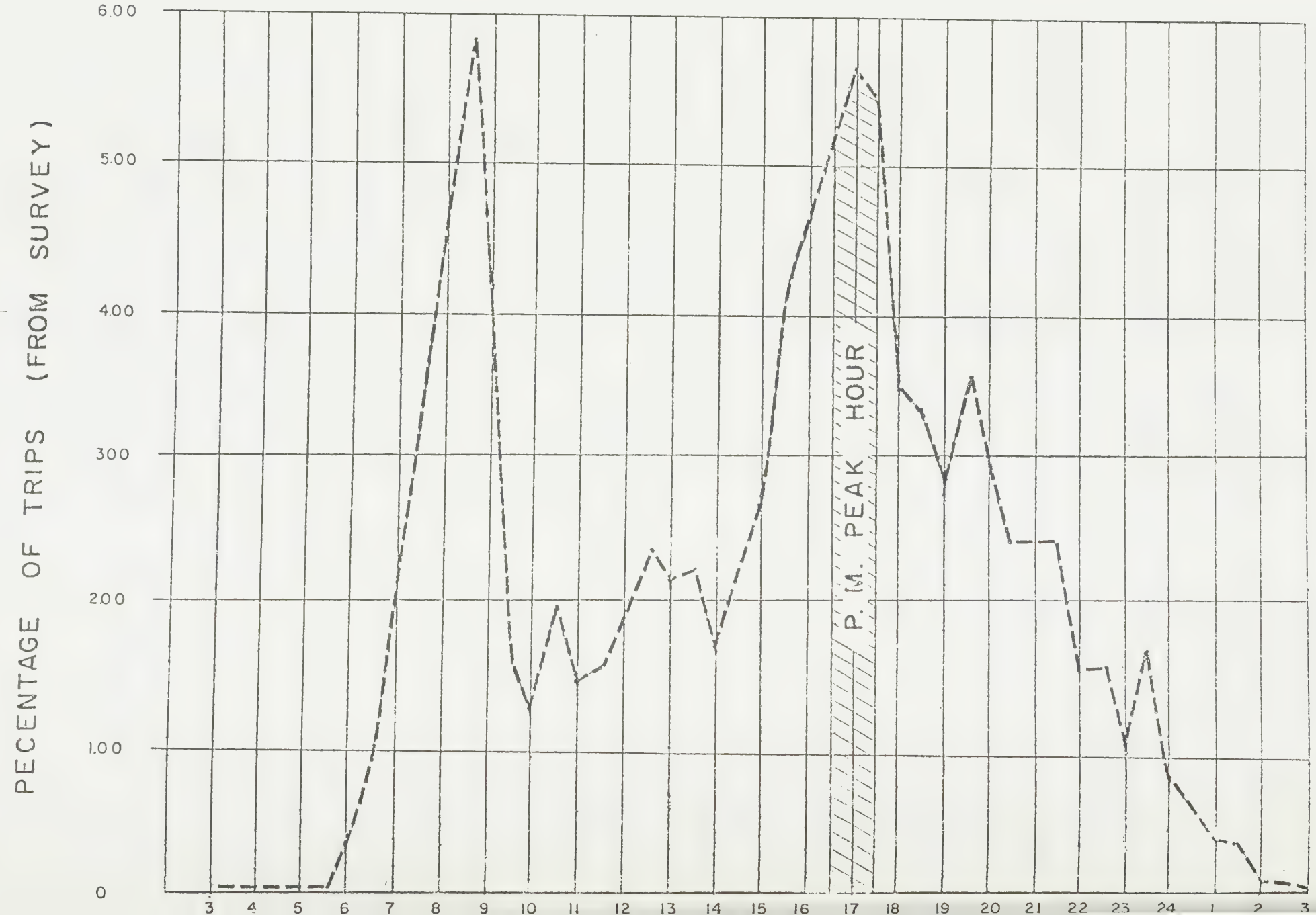


TABLE III

TRIP PURPOSE SUMMARY

| PURPOSE | PERCENTAGE TRIPS | |
|---|---|---|
| | 24 Hour | P.M. Peak Hour |
| TOTAL PERSON TRIPS | 100.0 | 100.0 |
| HOME BASED TRIPS | 83.6 | 86.1 |
| H.B. WORK | 32.4 | 50.6 |
| H.B. SHOPPING PERSONAL BUSINESS | 19.6 | 16.7 |
| H.B. SOCIAL RECREATION AND OTHER | 21.6 | 14.8 |
| H.B. SCHOOL | 10.0 | 4.0 |
| NON-HOME BASED | 16.4 | 13.9 |

## 3.4 TRIP GENERATION EQUATIONS

Trip generation equations have been developed for P.M. peak hour travel for home based work trips and for home based trips other than work trips. The trip production equations were developed as rates per household and per person and were developed for each of five different residential density categories. The trip rates at the non home end of trips were established in terms of land use indicators at these destinations.

The analysis gives an average of 0.142 home based work trips per person occurring during the P.M. peak hour. This trip production rate increased with increasing residential density. Table IV gives the trip generation rates for home based work trips as established from the survey data.

TABLE IV

P.M. PEAK HOUR-HOME BASED WORK TRIP GENERATION RATES

PRODUCTIONS

| POPULATION PER ACRE | | INDEPENDENT VARIABLES POPULATION |
|---|---|---|
| 0.1 | 10.0 | C x 0.119 |
| 10.1 | 20.0 | C x 0.136 |
| 20.1 | 30.0 | C x 0.139 |
| 30.1 | 40.0 | C x 0.131 |
| | 40.0 | C x 0.188 |

ATTRACTIONS

| EMPLOYMENT PER ACRE | MANUFACTURE & WHOLESALE EMPLOY. | INDEPENDENT VARIABLES RETAIL EMPLOY. | SERVICE & OTHER EMPLOY. |
|---|---|---|---|
| 0.1- 4.0 | 0.330 | 0.309 | 0.309 |
| 4.1-10.0 | 0.318 | 0.308 | 0.308 |
| 10.1-30.0 | 0.307 | 0.272 | 0.314 |
| 30.0 | 0.343 | 0.218 | 0.405 |

The analysis also produced P.M. peak hour trip generation equations for home based trips for purposes other than work. This travel consisted mainly of shopping, social and recreation with a small amount of school trips. The average production rate for this combined trip purpose during the P.M. peak hour is 0.293 trips per household. The trip rate for this purpose diminishes as the residential density increases. Table V gives the trip generation rate for this purpose.

TABLE V

OTHER HOME BASED TRIPS

PRODUCTION RATES

| RESIDENTIAL DENSITY (POPULATION/ACRE) | TRIP PRODUCTION 24 HOUR | RATE PER HOUSEHOLD P.M. PEAK HOUR |
|---|---|---|
| 0.1 to 10.0 | 4.283 | 0.370 |
| 10.1 to 20.0 | 2.960 | 0.288 |
| 20.1 to 30.0 | 2.445 | 0.217 |
| 30.1 to 40.0 | 2.032 | 0.176 |
| 40.0 | 1.275 | 0.157 |

LAND USE AS A TRIP ATTRACTOR

| LAND USE AT DESTINATION | PERCENT OF TOTAL TRIPS |
|---|---|
| MANUFACTURING | 2 |
| RETAIL & SERVICE | 61 |
| RESIDENTIAL | 26 |
| OTHERS | 11 |

3.5 TRIP LENGTH FREQUENCY

The distance or time a person is willing to travel or has to travel for a particular purpose is an important input in modelling travel demand. The survey data was used to calculate the trip length fre-

# FIGURE IV: TRIP LENGTH FREQUENCY DISTRIBUTION
## HOME BASED WORK

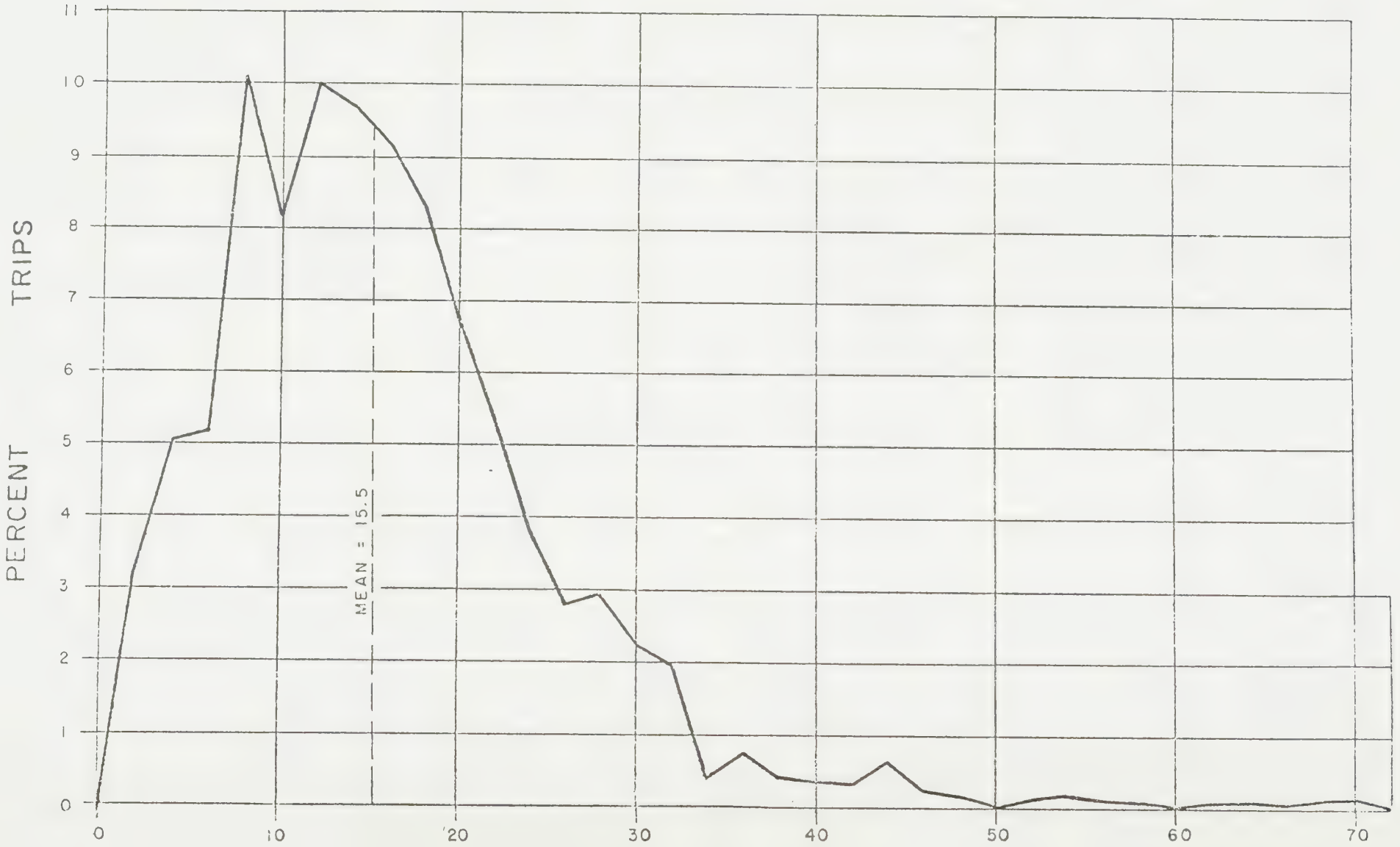
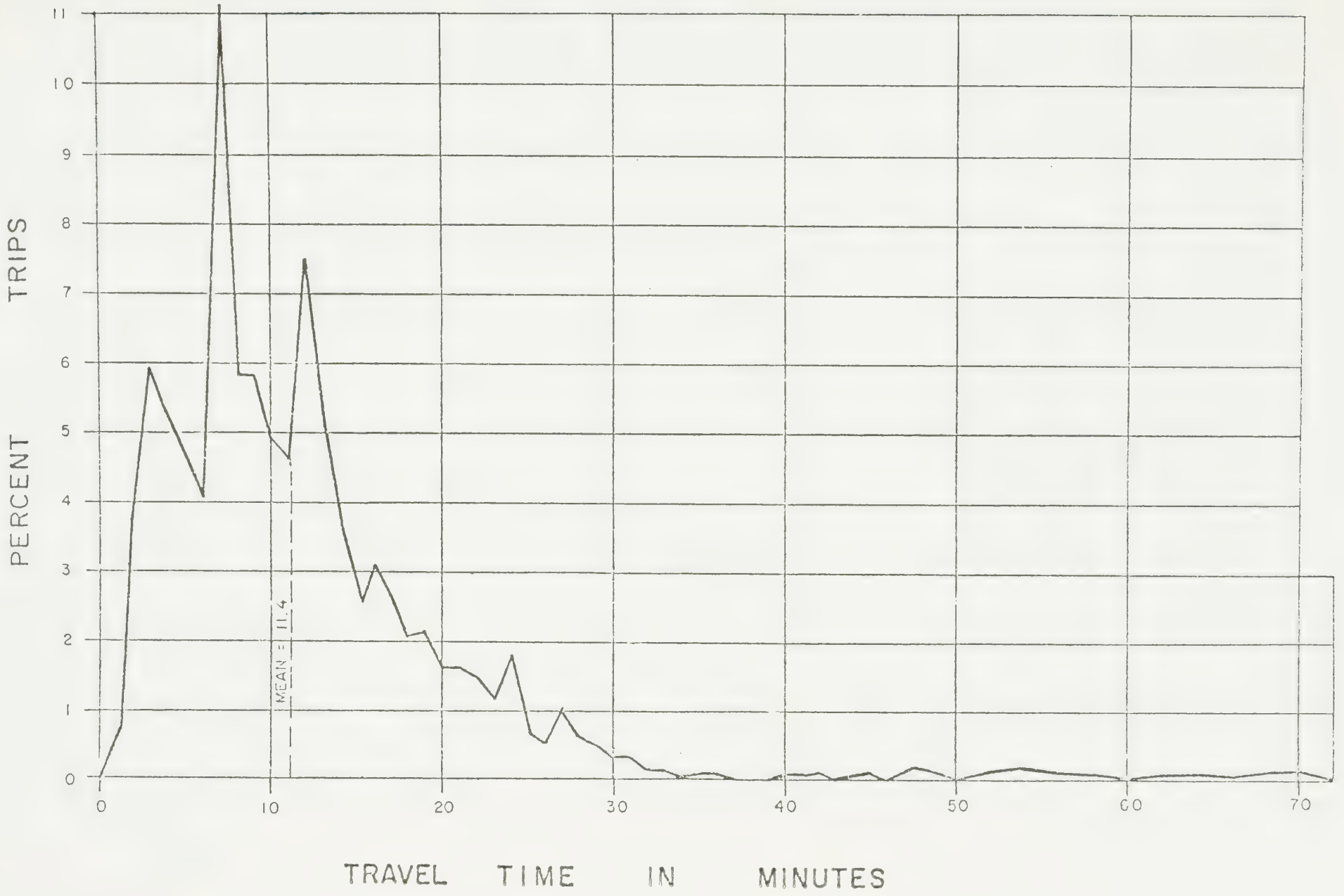


FIGURE V : TRIP LENGTH FREQUENCY DISTRIBUTION
OTHER HOME BASED



quency for each trip purpose. Figure IV shows the trip length frequency for home based work trips. The majority of people travel between 5 and 25 minutes for this purpose with the average travel time being 15.5 minutes. When the travel forecast model is used to simulate base year travel demand it should produce exactly the same trip length frequency. Figure V shows the trip length frequency for other home based trips. The majority of travel is between 2 and 13 minutes with the average travel time equal to 11.4 minutes.

## 3.6 DIRECTIONAL SPLIT

It is necessary to have a measure of the directional split of travel demand to fully understand the requirements for transportation facilities. During the P.M. peak hour the majority of travel consists of home based trips with either the trip origin or the trip destination at the residential location of the trip maker. The travel destined to the home end accounts for 82% of all home based travel during the P.M. peak with only 18% originating at the home end. The simulation models require directional split factors to modify trip matrices and simulate the actual direction of travel. For home based trips other than for the purpose of work 61 percent of the travel is destinated to the residential location during the the peak hour. For home based work 94% are destined to the residential location.

## 3.7 EXPANSION FACTOR

The traffic forecast models simulate from trip generation equations only home based travel in the P.M. peak hour. This home based travel accounts for only 86% of all travel in P.M. peak hours. To allow for non home based trips, simulated travel will be increased by a factor of 1.163.

3.8 CAR OCCUPANCY

The survey data shows that 49 percent of the population has a drivers licence and are able to drive an auto. Sixty percent of all travel is done by auto drivers. A further investigation shows that the average car occupancy is 1.413 persons per auto over the 24 hour period. The car occupancy during the P.M. peak hour drops to 1.304 persons per auto. Travel for purposes of home based work shows a further drop in the car occupancy rate to 1.063 persons per auto.

3.9 MODAL SPLIT

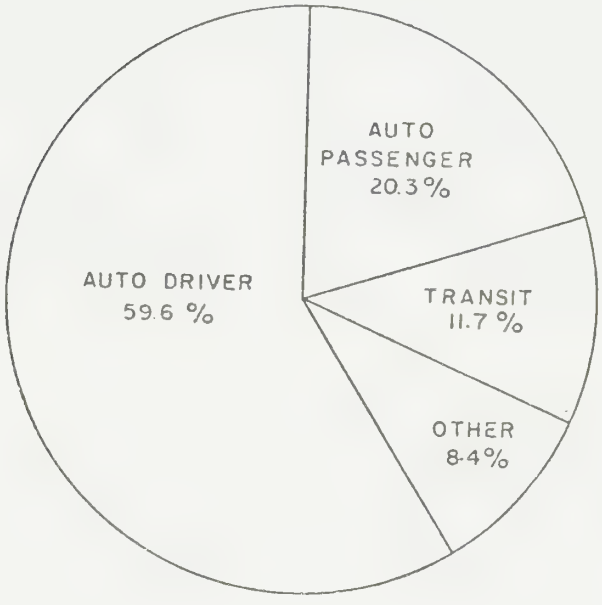
Figure VI shows the percent of person travel by the various travel modes for both the 24 hour period and the P.M. peak hour period. Public transit carries less than 12% of all person travel while over 60% of the person travel is done by auto drivers. The percentage of auto drivers increases to 65% during the peak travel demand. The transit ridership is made up of 88% captive riders (riders who do not have an auto available inwhich to make the trip.) In the P.M. hour 60% of the transit travel consists of home based work trips.

4. CHANGES IN TRAVEL CHARACTERISTICS

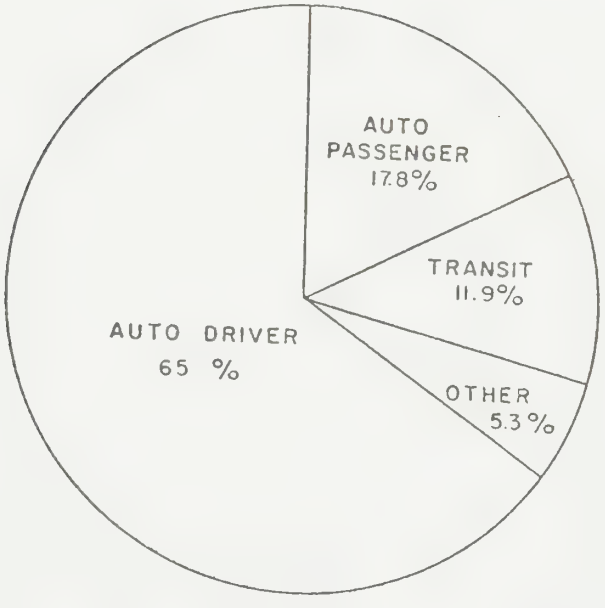
By comparing the survey results to information established in previous studies it is possible to obtain an estimate of changes in travel characteristics over time. Comparison of data summaries with similar summaries obtained from the Toronto Area Regional Model Study (TARMS) makes it possible to estimate changes in travel characteristics between geographic locations.

# FIGURE VI : 1974 CHARACTERISTICS SURVEY
# TRAVEL MODE SUMMARY

## 24 HOUR PERIOD




## P. M. PEAK HOUR PERIOD



The most obvious difference between the TARMS data and this is the variation of the importance of trip purposes. TARMS shows the home based work trip to account for 43% of all travel over a 24 hour period on an average week day and 71% of the P.M. peak hour travel, while this survey gives figures of 32 and 51 percent respectively. This difference in travel composition requires differences in the travel forecasting model. Comparison showed a strong similarity between the trip generation rates for home based work trips between the two studies for both the 24 hour period and the P.M. peak hour period. The similarities were strong enough to suggest that the home based work trip generation equations developed in TARMS could be applied to the Hamilton-Wentworth area with only a small loss in accuracy. However this survey developed a separate set of equations for use which vary slightly from the TARMS equations. Needless to say modal split relationships developed in TARMS do not apply satisfactorily in Hamilton-Wentworth because of the dominance of Toronto in the TARMS study.

Comparison of the survey summaries to survey data from the 1961 Hamilton Area Transportation Study (HATS) showed only minor changes in travel characteristics. The trip generation rate has increased slightly but the trip purpose composition has remained fairly stable through time. Trip generation equations developed by HATS were of an awkward form and could not be compared easily with equations established by this survey. The form of the trip generation relationships from HATS was undesirable for use in this study. Comparison of travel by mode shows a decrease in transit ridership and an increase in car drivers. There has been a significant increase in car ownership over the 13 years between surveys.

# CHAPTER I
# INTRODUCTION

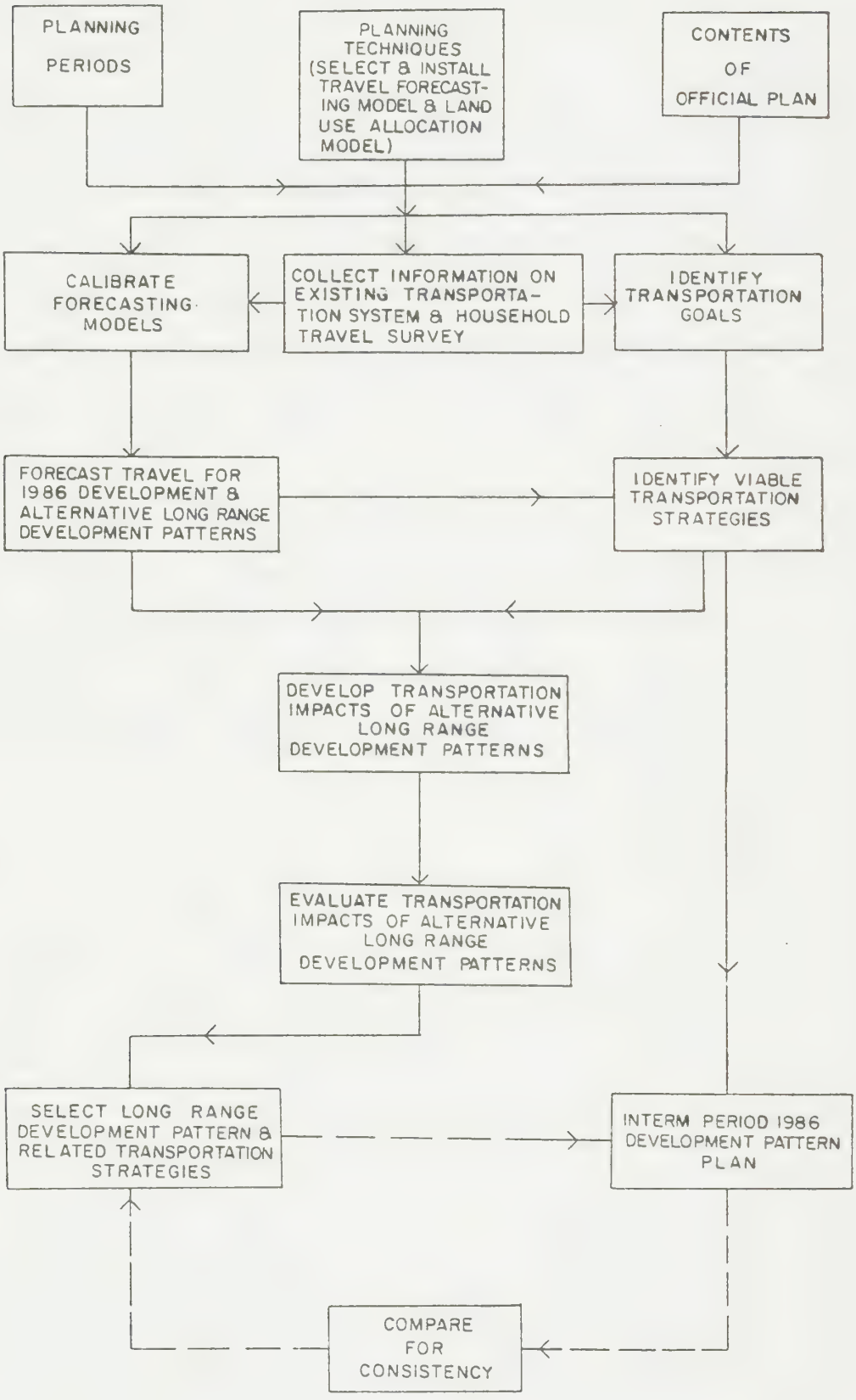
## 1.1 BACKGROUND

The Official Plan process for the Regional Municipality of Hamilton-Wentworth requires an assessment of the future needs for transportation facilities within the Region as well as an assessment of proposed development concepts in terms of transportation impacts. The Transportation Sub-study of the Official Plan has set up an analytical framework of procedures to aid in these assessments.

Figure 1.1 is a flow diagram of major activities to be carried out within the Transportation Sub-study. The group of activities classified as inventory includes the calibration of travel forecasting models. To achieve this calibration, detailed information is required concerning the travel characteristics of households within the Region.

The travel characteristics origin-destination survey was designed as part of the Transportation Sub-study to obtain basic information on travel demand within the Region. The survey was designed and conducted by the staff of the Planning and Development Department of the Regional Government of Hamilton-Wentworth in the months of September through December, 1974. Financial assistance was provided by the Ontario Ministry of Transportation and Communications in the form of a 75% subsidy. Technical analysis of the survey information was conducted by Regional Planning Department staff with the aid of computer facilities, programs and technical assistance supplied by the Municipal Planning Branch of the Ministry of Transportation and Communications

# FIGURE I.1: THE TRANSPORTATION SUB-STUDY


PLANNING PERIODS
PLANNING TECHNIQUES (SELECT & INSTALL TRAVEL FORECASTING MODEL & LAND USE ALLOCATION MODEL)
CONTENTS OF OFFICIAL PLAN
CALIBRATE FORECASTING MODELS
COLLECT INFORMATION ON EXISTING TRANSPORTATION SYSTEM & HOUSEHOLD TRAVEL SURVEY
IDENTIFY TRANSPORTATION GOALS
FORECAST TRAVEL FOR 1986 DEVELOPMENT & ALTERNATIVE LONG RANGE DEVELOPMENT PATTERNS
IDENTIFY VIABLE TRANSPORTATION STRATEGIES
DEVELOP TRANSPORTATION IMPACTS OF ALTERNATIVE LONG RANGE DEVELOPMENT PATTERNS
EVALUATE TRANSPORTATION IMPACTS OF ALTERNATIVE LONG RANGE DEVELOPMENT PATTERNS
SELECT LONG RANGE DEVELOPMENT PATTERN & RELATED TRANSPORTATION STRATEGIES
INTERM PERIOD 1986 DEVELOPMENT PATTERN PLAN
COMPARE FOR CONSISTENCY

of the Province of Ontario.

## 1.2 PURPOSE

The overall purpose of the origin-destination survey is to collect data pertaining to the travel characteristics of the area population. This information was then analysed relative to the land use and socioeconomic data for the area in order to determine the form of the parameters to be used in models for forecasting the future transportation demands in the Region.

The design of the travel forecasting procedures and the availability of information from other sources have had a major impact on the design of the origin-destination survey. Specific factors that affect this survey include the following:

1. The traffic modelling procedures are designed to forecast large corridor traffic volumes which are used in strategy policy planning.
2. The traffic forecasting models are designed to predict peak hour travel demand only.
3. The basic form of the necessary trip generation equations is available from the TARMS study which was conducted over a large study area including Hamilton-Wentworth. These equations should only need to be validated, and if necessary re-calibrated for use in this study.

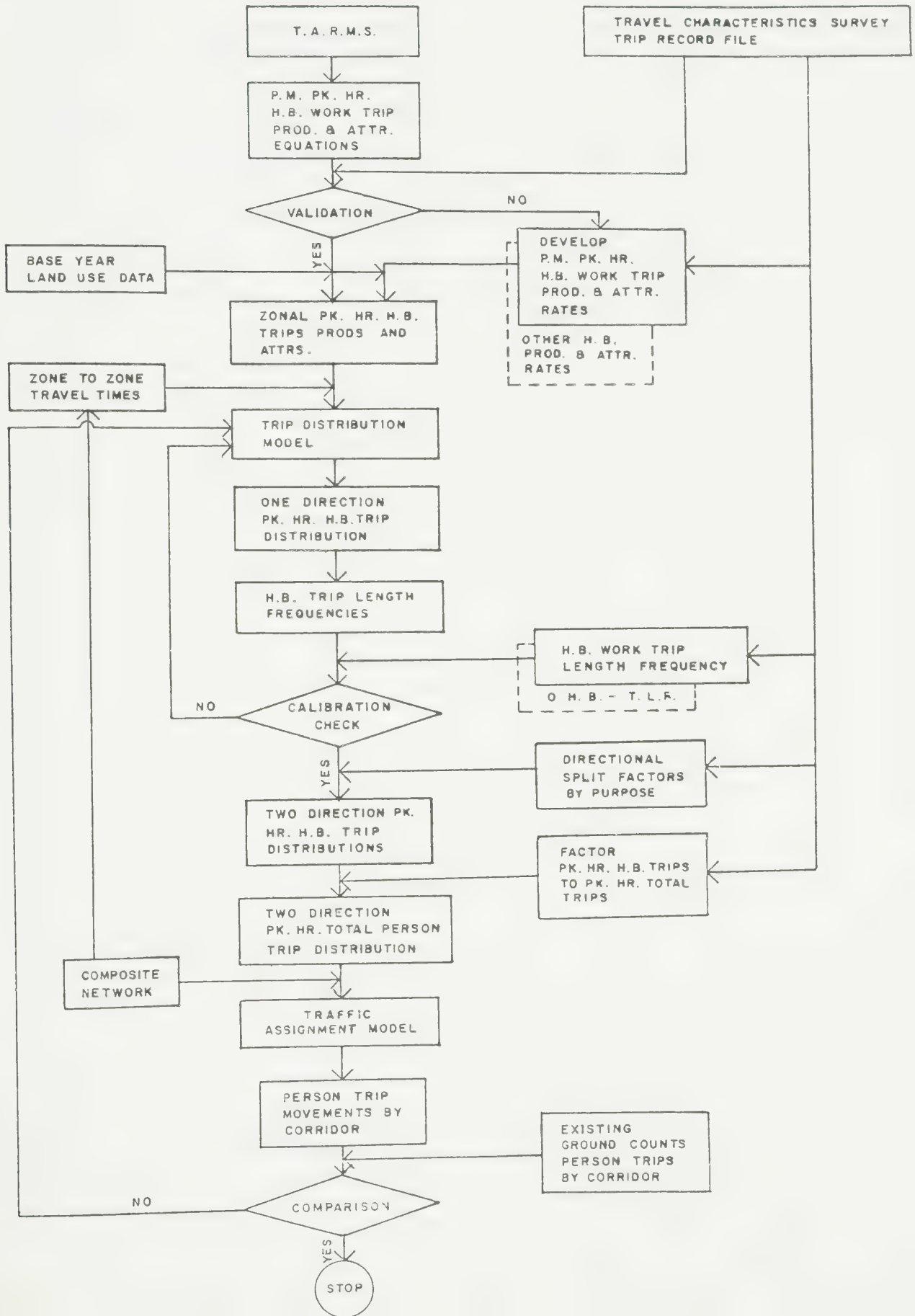
### 1.2.1 OUTPUT REQUIREMENTS

The output from the analysis of the O.D. Survey is used as input to the travel forecasting model validation and calibration procedure. Figure 1.2 outlines this procedure and specifies the input necessary from the travel characteristics survey. The major

components of the travel forecasting model validation and calibration procedure are as follows:

1. The P.M. peak hour H.B. work trip equations from the M.T.C. (TARMS) study must be validated. The production equations are by population density category and the attraction equations are by employment density category. The original TARMS equations are listed in Appendix D.
2. If the O.D. survey analysis suggests that the TARMS equations are unrepresentative of the study area then a new set of equations must be developed from the survey data.
3. The O.D. survey data is used to establish a trip length frequency by trip purpose. These are used as a standard and the travel impedance factors of the trip distribution portion of the travel forecasting model are varied until the model outputs similar trip length frequencies. This is a major component of the model calibration.
4. The survey data is used to establish P.M. peak hour Home Based trip directional split factors. These factors are used to invert the matrices of trips originating at the home and to achieve a simulation of trips starting at or destined to the home end.
5. The ratio of total person trips in the P.M. peak hour to Home Based trips in the same time span is established from the survey output. This factor is applied within the model framework to factor up the matrix of peak hour Home Based trips to represent all trips within the peak hour.
6. The O.D. matrix of peak hour person trips is assigned to a

# FIGURE 1.2: TRAVEL FORECASTING MODEL VALIDATION AND CALIBRATION PROCEDURE


T.A.R.M.S.
TRAVEL CHARACTERISTICS SURVEY TRIP RECORD FILE
P.M. PK. HR. H.B. WORK TRIP PROD. & ATTR. EQUATIONS
VALIDATION
NO
YES
BASE YEAR LAND USE DATA
DEVELOP P.M. PK. HR. H.B. WORK TRIP PROD. & ATTR. RATES
OTHER H.B. PROD. & ATTR. RATES
ZONAL PK. HR. H.B. TRIPS PRODS AND ATTRS.
ZONE TO ZONE TRAVEL TIMES
TRIP DISTRIBUTION MODEL
ONE DIRECTION PK. HR. H.B. TRIP DISTRIBUTION
H.B. TRIP LENGTH FREQUENCIES
H.B. WORK TRIP LENGTH FREQUENCY
O H.B. - T.L.F.
NO
CALIBRATION CHECK
YES
DIRECTIONAL SPLIT FACTORS BY PURPOSE
TWO DIRECTION PK. HR. H.B. TRIP DISTRIBUTIONS
FACTOR PK. HR. H.B. TRIPS TO PK. HR. TOTAL TRIPS
TWO DIRECTION PK. HR. TOTAL PERSON TRIP DISTRIBUTION
COMPOSITE NETWORK
TRAFFIC ASSIGNMENT MODEL
PERSON TRIP MOVEMENTS BY CORRIDOR
EXISTING GROUND COUNTS PERSON TRIPS BY CORRIDOR
NO
COMPARISON
YES
STOP

composite network. The simulated volume of person trips travelling in specified corridors and crossing specified screen lines is compared to ground counts of person trips in these corridors and across these screenlines. If the com parison is unfavourable then the model parameters for trip distribution can be adjusted. If the comparison continues to be unfavourable after a number of interactions the trip generation rates would be rechecked.

# CHAPTER II
# SURVEY DESIGN

## 2.1 BACKGROUND

The size of sample and the type of information collected in an origin destination survey is dictated by the method used to analyse the data, particularly with regard to trip generation analysis. The standard trip generation technique employing regression analysis on survey data aggregated to the traffic zone level requires a 6 percent sample of households within the area. By employing an analysis technique that utilizes each survey sample as input rather than a zonal aggregate of samples, the size of the survey sample can be reduced to less than 1 percent of the households in the study area. [1,2] For the Hamilton-Wentworth study area this means a sample of less than 1,500 households will be sufficient.

The cost and time requirements of the small sample approach are significantly less than the standard survey approach. The large scale O.D. survey would not have been possible due to the restrictions of the Official Plan budgeting and scheduling.

The information collected from each sample household was limited to that necessary to meet the output requirements specified in chapter one, and that necessary to analyse the statistical representations of the sample. It was decided that a standard telephone method of interviewing the sample household would be employed. Questions were asked regarding basic characteristics of the household and all household members over the age of five years, in addition to questions about all trips made by members of the household

over a 24 hour period. The interviews were scheduled so that they represented equally the five weekdays.

Figure 2.1 is a flow diagram of scheduled activities within the framework of the Travel Characteristics Survey. The flow diagram covers the activities to the end of the analysis stage of the survey data.

## 2.2 STUDY AREA AND INTERNAL ZONING

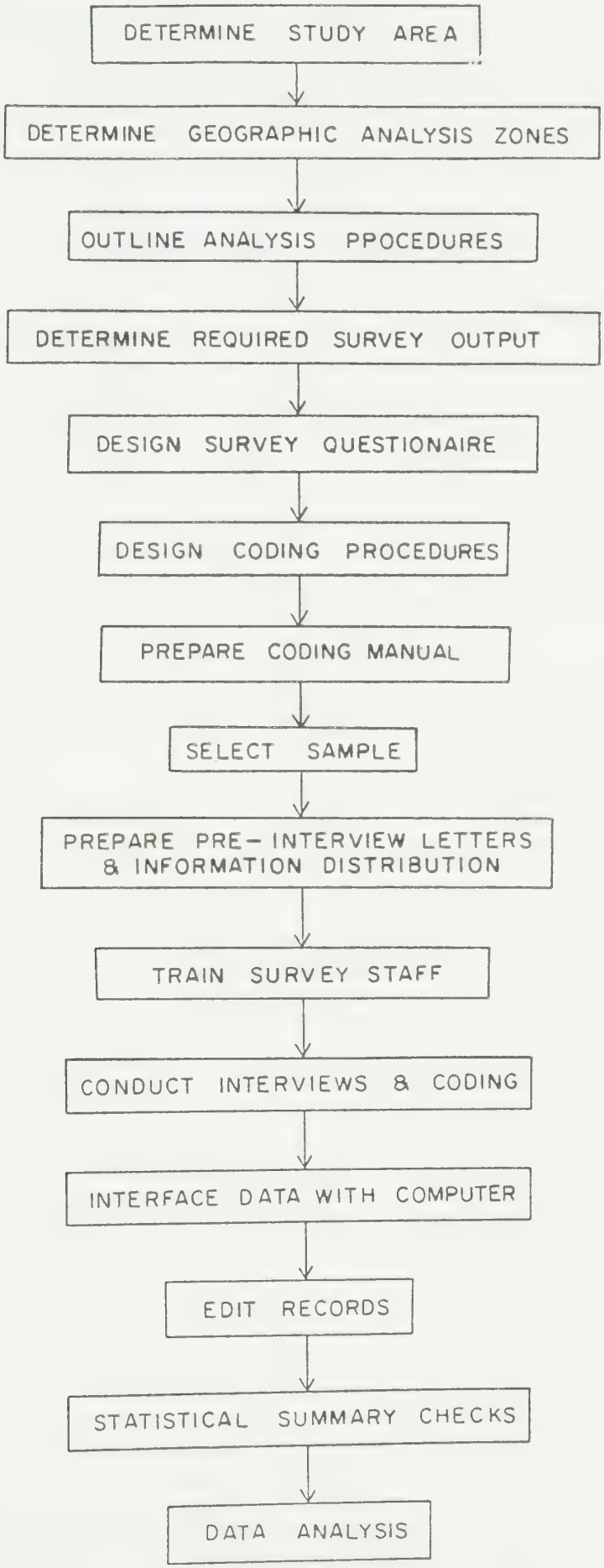
The boundaries of the study area were decided upon during the design of the Transportation Sub-study. The study area includes the Regional Municipality of Hamilton-Wentworth and the city of Burlington. Burlington was included because of the strong transportation interaction between the cities of Hamilton and Burlington. This interaction can best be accounted for by including Burlington in the modelling exercise when forecasting internal trips.

The geographic zones used in the O.D. survey are the same as those developed for the study area for the TARMS study. The zone numbering system was adjusted for convenience of use during this study. The study area and the internal traffic zones are shown on Figure E-1 (Appendix E).

## 2.3 SAMPLE SELECTION

The sample was originally designed to contain approximately 1,500 households to be chosen in a random manner by address so as to represent the total population of the Regional Municipality of Hamilton-Wentworth and the City of Burlington. The sample selection was carried out in such a fashion that the geographic distribution of the sample is representative of the geographic distribution of households within the study area.

# FIGURE 2.1: O.D. SURVEY ACTIVITIES



The method of indentifying the sample household addresses was with the use of the local assessment files of the municipalities and townships within the study area. The number of sample households chosen within each of the municipalities is proportional to the percentage of the study area households within that community.

Information on the percentage of households in each of the municipalities and townships within the Region was derived from the following sources:

1. Standard Assessment System February 21, 1974
   Analysis of taxable Real Property and Business Assessment for 1973.
2. Report 2 Reg. 19 C.T. 25 M.N. 18 Regional Municipality of Hamilton-Wentworth
3. For the City of Burlington the percentage was derived from the Dominion Bureau of Statistics report "Housing Statistics - CMHC Final Data - Year End 1973.

Based on the figures from these reports and the total desired number of households of 1,500 the following breakdown on the number of sample households was established.

The address of each sample household was obtained from the assessment rolls of each community. The total number of households in the study area was approximately 150,000, so to achieve a sample of 1,500 households it was decided to choose every 100th residential unit from the assessment files (n=100). The assessment files are compiled in such a manner that by choosing every nth entry the randomness and the geographic distribution of the sample is guaranteed. The sample was taken from the assessment

TABLE (2.1)

DESIRED SAMPLE DISTRIBUTION

| COMMUNITY | NO. OF SAMPLE HOUSEHOLDS | % OF TOTAL |
|---|---|---|
| Ancaster | 38 | 2.53 |
| Burlington | 274 | 18.27 |
| Dundas | 52 | 3.47 |
| Flamborough | 61 | 4.07 |
| Glanbrook | 26 | 1.73 |
| Hamilton | 967 | 64.46 |
| Stoney Creek | 82 | 5.47 |
| TOTAL | 1500 | 100 |

files manually in all the municipalities except for Hamilton where a computer listing was utilized.

By selecting every 100th residential household from the assessment files the final size of the sample was not guaranteed to be exactly 1,500. The total number of samples selected was 1,638 but this extra of 138 was distributed proportionately between the municipalities and it was therefore retained in the sample. The samples finally selected are as follows:

TABLE (2.2)

SELECTED SAMPLE DISTRIBUTION

| COMMUNITY | NO. OF SAMPLE HOUSEHOLDS | % OF TO |
|---|---|---|
| Ancaster | 34 | 2.44 |
| Burlington | 285 | 17.52 |
| Dundas | 53 | 3.36 |
| Flamborough | 68 | 3.85 |
| Glanbrook | 25 | 1.65 |
| Hamilton | 1084 | 65.93 |
| Stoney Creek (Saltfleet) | 85 | 5.25 |
| TOTAL | 1634 | 100 |

A master list of the survey sample was compiled with every sample assigned a sample number. The list contained the address and the name of the family residing at the address as well as the telephone number if available.

The assessment records used to select the sample gave no information concerning telephone numbers. These had to be acquired with the use of the Bell Telephone Directory, the Vernon Directory and the listing services of Tele-Direct (a service company associated with Bell). A total of 1,384 (84.5%) of the sample households were assigned telephone numbers utilizing these sources. The remaining 254 (15.5%) of the sample households had to be scheduled as personal contact interviews with the interviewer obtaining the information at the sample household address.

## 2.4 INTERVIEW PROCEDURES

### 2.4.1. SCHEDULING

The survey interviews were scheduled to be completed over a four month period from September to December, 1974. Excluding a week for staff training there were 68 working days in the 4 month period. This meant that an average of 25 interviews had to be completed every day.

The scheduling of interviews started from 5 different points in the master list and proceeded daily from these to avoid the possibility of a non-uniform coverage of the survey sample.

### 2.4.2. NOTIFICATION TO SAMPLE HOUSEHOLDS

Each sample household was notified by mail approximately one week in advance of the date on which an interviewer was scheduled to contact them. The letter was addressed to the family name and address as indicated on the survey master list with the option "OR OCCUPANT" plainly marked on the envelope in case the name obtained for the sample was incorrect. The letter explained the purpose of the survey and informed the occupant of the date on which they would be contacted. The letter was signed by the Chairman of the Hamilton-Wentworth Region for all those samples within the Region and by the Chairman of the Halton Region for those samples in Burlington.

Included with the letter was a "Trip Log Table" to be completed by the members of the sample household and an "Instruction Sheet" outlining the procedures to be following in filling out the Trip Log Table. The information on this table was for the purpose of 'jogging-the-memory' of the person interviewed and was not intended to be sent back by the sample household. All information was to be conveyed by telephone except for those

samples scheduled as personal contact interviews.

Samples of the pre-interview letters, the Trip Log Table and the Instruction Sheet are contained in Appendix B.

To increase awareness of the survey within the study area a press conference was held the first week of the survey. Representatives from the Regional and local newspapers, the local T.V. station and local radio stations attended. A formal press release was handed out and the Regional Chairman and members of the planning staff answered questions concerning the survey. A copy of the press release is contained in Appendix C.

2.5 PERSONNEL

The main source of personnel was through the local Community College (Mohawk College) from which three co-op students were hired for the four month duration. Two other temporary staff members were hired through the local employment office of Canada Manpower. The staff consisted of three males and two females. In addition to the temporary staff there was a survey supervisor who was a permanent staff member of the Planning Department.

A training period of 1 week was set aside to familiarize the staff with the survey design and the interview and coding procedures. A manual was prepared for the staff containing an outline of procedures and definitions of terminology as well as examples of interview dialogue. An additional sample list was prepared and these samples were interviewed by the staff in the training sessions. Regular meetings were scheduled with the staff to discuss common problems and to develop the best interview technique.

2.6 CODING

The information obtained from each sample household was

coded in such a manner that it could be analysed rapidly with the aid of an electronic computer. A purely numeric coding system was chosen for use so as to cause minimum confusion in the analysis procedures.

The survey forms were designed so that the information could be coded for keypunching directly from the form. In the answer blocks for each question the appropriate number of coding blocks were provided to enter the corresponding numerical code. These coding blocks were numbered consecutively from one.

Information extracted from the samples was broken down into three distinct categories which were coded on three distinct record types. Record Type One contains household information and there is only one of these for each sample household. Record Type Two contains person information for every person over 5 years of age in each sample household. Record Type Three contains trip information and there is one record for every trip made by every person in each sample household.

Each sample household is identified by a distinct sample number and this sample number appears on each record containing information on a particular sample. Each person in a particular sample household is identified by a distinct person number and this number appears on the person record for that person and on every trip record concerning trips made by that person. Every trip made by each person is identified by a distinct trip number. Therefore each individual trip record can be identified by a distinct combination of sample, person and trip numbers.

All questions that could be answered by a simple yes or no were coded 1 for yes and 2 for no. Questions with a numerical answer were coded with the appropriate numerical value. All

other questions have their answers categorized in such a manner that distinct numbers represent each category.

The coding of all information was outlined in the coding manual and is quite straightforward except for those questions involving geographic location (i.e. trip ends). Geographic locations were recorded as street addresses, nearest intersections or name of prominent buildings during the interview. In order to identify a location by a purely numeric code it was necessary to use some form of geographic coding. The traffic zones developed for the TARMS study were renumbered for use in the survey. All geographic locations were identified by the traffic zone number in which they were located.

A procedure was developed to quickly identify the geographic zone in which any address, intersection or building is located. A detailed street index directory could not be developed due to time and monetary constraints, so a procedure was developed using previously established sources. The city of Hamilton had developed a street index by neighbourhoods. An equivalency table allowed the use of this index to identify traffic zones within the city. In the suburban and rural areas a combination of a county street index, zoning maps and the Vernon's Directory was used. The zone identification procedures proved to be quite effective once the survey personnel familiarized themselves with the technique and the study area. Trip ends outside the study area were coded to an external zone system. External zones are large enough that trips outside the study area had to be identified only by town or city.

## 2.7 QUALITY CONTROL

The O.D. survey had a full time supervisor who coordinated survey operations and performed quality control checks on survey data on a continuing basis. It was also part of his function to modify procedures to eliminate any irregularities during survey operations.

The coding of the questionnaires was part of the quality control function. Each coder checked for discrepancies in survey information. Occasionally a completed questionnaire was checked by the supervisor before coding. All coded questionnaires were checked by the supervisor for errors, in coding. The supervisor chose a random selection of approximately 10% of the samples and telephoned them after the questionnaire was completed. The sample household was asked to comment on the politeness of the surveyor and checks were made on the information on the questionnaire. Errors discovered by the supervisor were discussed with the interviewers. The supervisor conducted some statistical cross classification tests to make sure that certain statistical averages did not vary significantly from one interviewer to the next.

# CHAPTER III

# SURVEY OPERATIONS

## 3.1 WORK LOAD

The Travel Characteristics Survey was scheduled to extend over a four month period from September to December, 1974. After a one week training period for personnel, the survey started on September 10 and finished on December 13, 1974.

At first, only three of the five employees were employed in telephoning the survey sample households. The other two employees coded the completed interviews and prepared the letters of survey notification.

For the first two weeks of the survey, only 25 interviews were scheduled per day. By the end of September the daily work load had been increased to 30 interviews per day and for the months of October and November the staff scheduled 35 interviews per day. Personal contact interviews began on October 4, and this required the full time attention of one employee. At this point, two interviewers conducted the telphone interviews and were able to handle between 25 and 30 interviews per day. The coding was done by the remaining two staff members. The tasks of coding and interviewing were changed weekly to help make the job more interesting and to give each of the staff experience in all aspects of the survey.

Under supervision, the coders selected the sample and sample numbers to be interviewed one week in advance of the interview date. For each sample, the sample name, address and telephone number were entered on the Dwelling Unit Summary Form. Each sample number was recorded onto the Administrative Record, the

Dwelling Unit Summary form and in the top location of one copy of the Internal Record Form. The zone number, in which the sample address was located, was entered on the Dwelling Unit Summary Form and the top location of the Internal Trip Record Form. The sample numbers were entered into the Home Interview Assignment Record along with the date that the interview was assigned. The assigned interviews were then filed in an out filing system for the appropriate day of the week when the interview was scheduled to be conducted. As well, the appropriate dates were stamped on the cover letter and instruction sheet and sent to each sample household (dates stamped with the day that travel data was to be recorded and the day on which the interview would be conducted).

Approximately 1870 pieces of mail were sent out over a period of 60 days, averaging about 31 letters per day. This includes letters for personal interviews, rescheduling for a second telephone call and first attempts at telephone contact.

The last four weeks of the survey required that more manpower be allotted to personal interviewing. In the last two weeks two cars employing two interviewers were required to carry the load of personal interviewing.

## 3.2 QUALITY CONTROL PROCEDURES

When the interviewer had completed a sample interview it was submitted to the coders for coding of all information. Occasionally a completed questionnaire was checked by the supervisor before coding. All coded questionnaires were checked by the survey supervisor to be sure that coding was done correctly. Of the 1410 completed interviews 1123 were completed on the phone. Approximately 115 (10%) of these samples were

randomly checked by phone calls. Questions in this procedure were usually directed toward the Dwelling Unit Summary Form (number of vehicles, family members age, whether the member of the family drove a car, occupation, industry). For the Internal rip Report Form the main concern was work trips. Of the samples checked very few errors were found. The most frequent error was recording the wrong number of vehicles per family and confusing private and company owned autos. As well 60 (5%) of the samples were checked for errors in traffic zone coding. Any errors found were first reported to the interviewer or coder who made the error, then to the employees as a group. An additional step to ensure that all trips were being obtained from each interviewer was to compute the average number of trips for each interviewer by categories according to household size and car ownership. If the averages obtained from one interviewer were significantly different from the average of all the samples in one category (e.g. of a category one person household with 1 car) or from the other interviewers then the source of the discrepancy was sought. The main reason for discrepancy was usually traced to a large number of trips by very few samples in a particular category. This procedure provided information on the number of completed interviews and the average number of trips per household by the individual interviewer (and all the interviewers in the group), stratified by household size and the number of vehicles available. Table (3.1) shows the type of form used to record the above information.

TABLE (3.1)

TRIP CATEGORY FORM

| | | PEOPLE PER FAMILY | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | | | | 2 | | | | 3 or more | | | |
| Sample Number | Number of Trips | No Car | 1 Car | 2 Cars | 3 Cars | No Car | 1 Car | 2 Cars | 3 Cars | No Car | 1 Car | 2 Cars | 3 Cars |
| | | | | | | | | | | | | | |

3.3 SUMMARY OF RESULTS

Table (3.2) gives a monthly breakdown of the questionnaires including those that were uncompleted and dropped, those that had to be rescheduled and those originally scheduled as personal interviews.

TABLE (3.2)

MONTHLY SUMMARY OF HOME INTERVIEW O-D SURVEY

| MONTHS | COMPLETE | INCOMPLETE | RESCHEDULE TO TELEPHONE | RESCHEDULE PERSONAL INTERVIEW | SCHEDULED PERSONAL INTERVIEWS |
|---|---|---|---|---|---|
| September | 380 | 41 | 21 | 44 | - |
| October | 490 | 65 | 31 | 56 | 125 |
| November | 439 | 59 | 31 | 56 | 172 |
| December | 101 | 59 | - | - | 120 |
| TOTAL | 1410 | 224 | 83 | 156 | 417 |

3.3.1. COMPLETED QUESTIONNAIRES

The largest number of samples completed in a one week span (October 8 to October 12) was 139 acceptable questionnaires. The least number completed occurred in the last week (December 10 to December 13) with only 21 acceptable questionnaires. The average number of questionnaires completed per week was approximately 101.

Completed questionnaires can be categorized into three types. Of the 1410 that were acceptable 1061 (75.25% of the total completed) were completed on the first attempt on the telephone, 62 (4.40% of the total completed) were completed after a second letter and a new assignment date on the telephone and 287 (20.35% of the total completed) were completed as personal interviews.

3.3.2. INCOMPLETE QUESTIONNAIRES

The total number of incomplete questionnaires amount to 224. Of this number 96 (42.86% of the total incomplete) were dropped on the first attempt on the telephone, 11 (4.91% of the total incomplete) were dropped after a second rescheduling for the telephone and 117 (52.23% of the total incomplete) were dropped during personal interviewing. The largest category of incomplete questionnaires came about due to refusal to cooperate. A summary of the type of incomplete questionnaires is provided in table (3.3).

TABLE (3.3)

SUMMARY OF INCOMPLETE SAMPLES

| REASON FOR SAMPLE DROPS | NUMBER DROPPED | PERCENTAGE OF TOTAL INCOMPLETE | PERCENTAGE OF TOTAL SAMPLES |
|---|---|---|---|
| Refusal | 116 | 51.78 | 7.10 |
| Vacant | 59 | 26.34 | 3.61 |
| Language | 14 | 6.25 | 0.86 |
| Illness | 5 | 2.23 | 0.31 |
| No Such Address | 17 | 7.59 | 1.04 |
| Out of Study Area | 5 | 2.23 | 0.31 |
| Demolished | 4 | 1.79 | 0.24 |
| Commercial Structure | 4 | 1.79 | 0.24 |
| TOTAL | 224 | 100.00 | 13.71 |

### 3.3.3. RESCHEDULING

If an interview sample was not reached on the first call, the interviewer called back until the sample household was contacted. These call backs could take place anytime over a three day period (the scheduled interview day and the following two days). If the interviewer was unable to contact the household at the sample address within the three days allowed for, the sample was either rescheduled to be phoned again at a later date or was rescheduled as a personal interview. Rescheduling for a second telephone interview at a later date took place only when it was established (by calling neighbours, superintendent, checking the telephone directory and using the Vernons Directories) that the occupants name and address were correct. Any other case required a personal interview. If a person requested a later date for a telephone interview or a personal interview due to illness, skepticism about the purpose

of the survey or any other viable reason, the sample interview was rescheduled.

A total of 239 questionnaires required rescheduling. Those samples that were rescheduled to be telephoned again at a later date numbered 83 (34.73% of the total rescheduled) while personal interviews accounted for 156 (65.2% of the total rescheduled) of the number of samples rescheduled.

3.3.4. SURVEY RESPONSE BY MUNICIPALITY

Table 3.4 shows the number of survey samples completed and not completed for each of the local municipalities. The overall completion rate was 86.29 per cent of the assigned samples. The response was best in Ancaster and Dundas where a total of only three samples had to be dropped. The other municipalities were all close to the average completion rate with the city of Hamilton having the lowest response rate (15% of the original samples were dropped).

The last column of the table gives the final distribution of the completed samples among the municipalities. This compares favorably with the desired sample distribution shown in Table 2.1 of this report.

3.4 PERSONAL INTERVIEWS

The most difficult samples to obtain in the survey were those that had to be assigned as personal interviews. A total of 417 samples were assigned as personal interviews. Five of these interviews were rescheduled for the telephone and eight had to be rescheduled a second time as personal interviews. These 13 interviews were completed. Of the total number of personal interviews 287 were completed and 117 had to be dropped.

TABLE (3.4)

RESPONSE BY MUNICIPALITY

| COMMUNITY | COMPLETE | INCOMPLETE | PERCENT IN COMPLETE FOR MUNICIPALITY | PERCENT OF TOTAL COMPLETED PER MUNICIPALITY |
|---|---|---|---|---|
| Ancaster | 33 | 1 | 2.94 | 2.34 |
| Burlington | 247 | 38 | 13.33 | 17.52 |
| Dundas | 51 | 2 | 3.77 | 3.62 |
| Flamborough | 59 | 9 | 13.20 | 4.18 |
| Glanbrook | 22 | 3 | 12.00 | 1.56 |
| Hamilton | 924 | 160 | 14.76 | 65.53 |
| Stoney Creek | 74 | 11 | 12.94 | 5.25 |
| TOTAL | 1410 | 224 | 13.71 | 100.00 |

Table (3.5) gives the results of the personal interviews.

TABLE (3.5)

| SUMMARY OF THE RESULTS OF PERSONAL INTERVIEWS | TOTALS | % OF TOTAL PER. INTER. |
|---|---|---|
| Completed (first attempt) | 287 | 68.82 |
| Incomplete | 117 | 28.06 |
| Rescheduled to Telephone | 5 | 1.20 |
| Rescheduled a second time to Personal Interview | 8 | 1.92 |
| TOTAL | 417 | 100.00 |

The number of personal interviews that had to be dropped is shown on Table (3.6) in eight different categories. The number of refusals was smaller than expected while the number of vacant dwellings was larger.

TABLE (3.6)

| SUMMARY OF PERSONAL INTERVIEW SAMPLES THAT WERE INCOMPLETE | NO. | % OF TOTAL P.I. DROPPED |
|---|---|---|
| Commercial Structure | 1 | .85 |
| Demolished | 4 | 3.42 |
| Illness | 0 | 0.00 |
| No such address | 14 | 11.97 |
| Out of Study Area | 4 | 3.42 |
| Refusal | 54 | 46.15 |
| Vacant | 40 | 34.19 |
| Vacation | 0 | 0.00 |
| TOTAL | 117 | 100.00 |

### 3.4.1. ASSIGNMENT OF PERSONAL INTERVIEWS

A certain number of telephone interviews were rescheduled to be done as personal interviews. If the sample could not be contacted within three days of being assigned on the telephone it was rescheduled as a personal interview under the following circumstances: wrong phone number, a new tenant, a telephone out of service, a person requesting a personal interview or a language problem. Rescheduling to personal interview only took place after all means of attempting to contact by telephone were exhausted. The procedures used to attempt to contact by telephone were: consulting the telephone directory, Vernon's Directories and calling neighbours or superintendents of apartment buildings. Of the total number of samples (1634), 156 had to be rescheduled as personal interviews. A total of 261 were originally assigned as personal interviews.

### 3.4.2. MILEAGE AND INTERVIEWS ASSIGNED

The personal interviews began on October 4 and were completed on December 13, a total of 46 working days. One vehicle was used almost entirely throughout the survey, except for the last ten days when the large number of personal interviews required use of a second vehicle. Depending on the circumstances, one or two people were assigned to a vehicle.

The number of personal interviews which could be assigned to one interviewer in a day varied according to the distance between interviews. More could be assigned in Hamilton than in the area municipalities. For one person interviewing in Hamilton, it was found that 10 interviews per day was an

adequate assignment. In the rural areas, because of the greater distances between samples, five per day was normal. With two interviewers to one vehicle, 15 samples were covered in the urban areas and 10 in the rural areas. A negative feature with this set-up was an increase in mileage.

To help save on mileage and time, personal interviews were grouped and assigned daily to traffic zones which were in close proximity to each other. By keeping all the interviews for the day within no more than seven bordering traffic zones a great deal of time was saved in the Hamilton area. This system could not be applied effectively in rural areas because of the greater distances between sample interviews and the fact that exact addresses were sometimes not known.

In the first week of personal interviewing (October 1-5) only 10 samples were scheduled, using one vehicle and one interviewer. By the second to last week (December 3-7) 101 personal interviews were scheduled using two vehicles with two interviewers assigned to each. Table (3.7) gives the number of personal interviews scheduled per week for the length of the survey.

The total mileage for both vehicles used was 1859 miles. Table (3.8) gives a breakdown of the total mileage, the total number of days, the average number of interviews per day, the average number of miles per interview, and the average number of miles per day.

TABLE (3.7)

SUMMARY OF PERSONAL INTERVIEWS SCHEDULED PER WEEK

| WEEK | SCHEDULED PERSONAL INTERVIEWS |
|---|---|
| October 1 - 5 | 10 |
| October 8 - 12 | 20 |
| October 16 - 19 | 20 |
| October 22 - 26 | 30 |
| October 29 - November 2 | 45 |
| November 5 - 9 | 47 |
| November 13 - 16 | 30 |
| November 19 - 23 | 40 |
| November 26 - 30 | 55 |
| December 3 -7 | 101 |
| December 10 - 13 | 19 |
| TOTAL | 147 |

TABLE (3.8)

| TOTALS AND AVERAGES FOR ALL PERSONAL INTERVIEWS | |
|---|---|
| Total Number of Personal Interviews | 417 |
| Total Mileage | 1859 |
| Total Days | 46 |
| Average Number of Interviews Per Day | 9.0 |
| Average Number of Miles Per Interview | 4.5 |
| Average Number of Miles Per Day | 40.4 |

### 3.4.3. PROBLEMS ENCOUNTERED IN PERSONAL INTERVIEWS

The only real problems in the survey came about while trying to complete personal interviews in rural areas. Wrong telephone numbers and incorrect addresses made it difficult to get in touch with selected samples. Often, the covering letter, sent out one week in advance, would not arrive in time. As well, it was found that homes were not numbered, or were numbered out of sequence in rural areas. Neighbours of the selected samples were often unable to help in locating people because of frequent changes in property ownership and property renters.

The procedure used to get around the above problems was to contact the local post office or town hall in the area of the interview. When obtaining information from these sources on rural route addresses it was found to be advantageous to phone and discuss the problem before going to them. When seeking an address which involves a group mail box, the post office informed us that they usually assigned the box numbers of past occupants to the present occupant of a residence. This made contacting people who had recently moved into their residence easier.

# CHAPTER IV
# SURVEY ANALYSIS TECHNIQUES

## 4.1 ANALYSIS METHODOLOGY

The analysis of the survey information required the aid of high speed computing equipment and specialized computer programs. This was necessary due to the large amount of data collected and the wide variety of data summaries required as output.

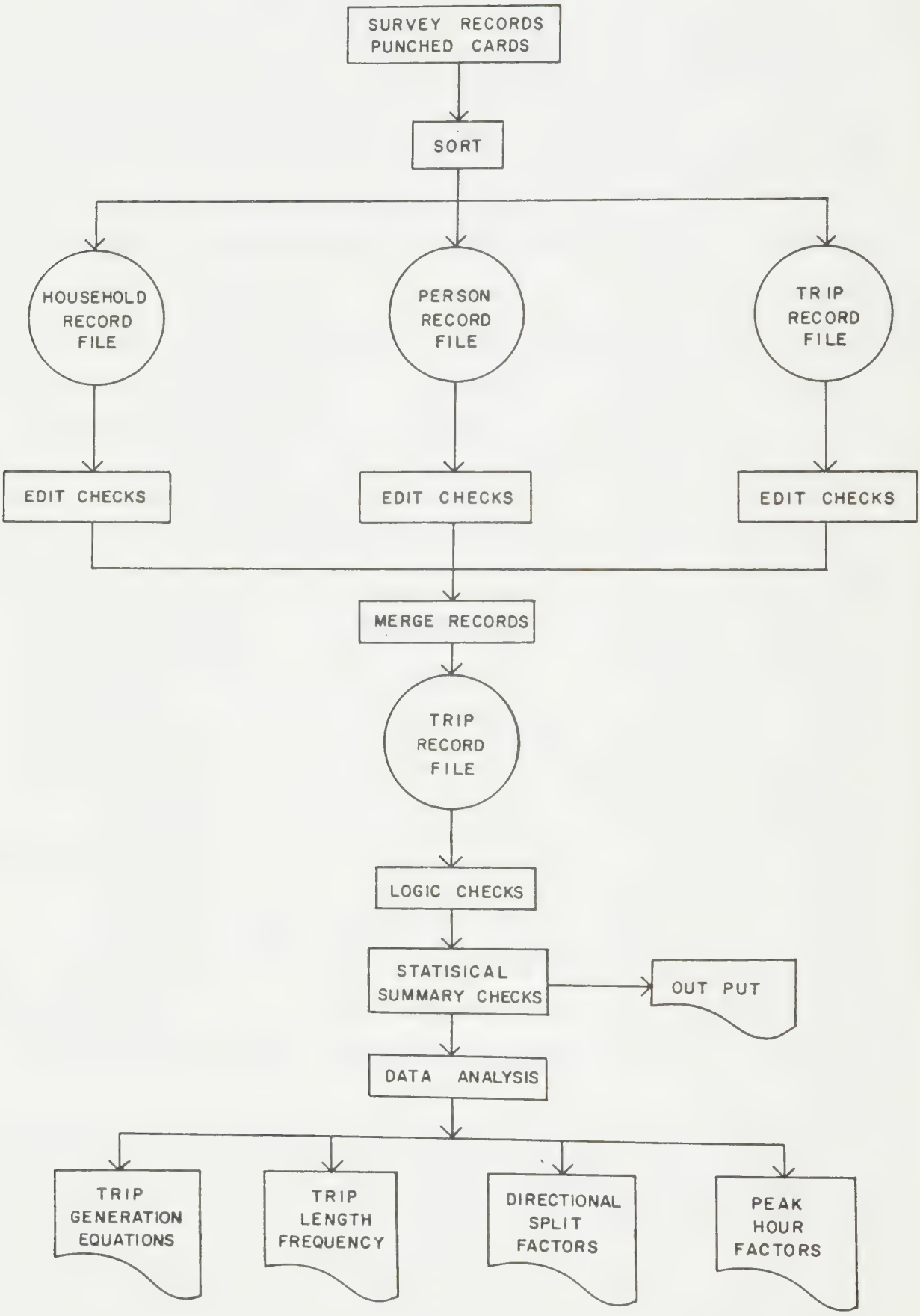
The survey questionnaires, once they had been completed, coded and checked, were then sent to be keypunched. The numerically coded information from the questionnaires was punched on computer punch cards ready for input to the computer. All key punch cards for the survey were verified to minimize the possibility of error.

The computer programs necessary for the analysis of the survey information were available only at the Ministry of Transportation and Communication. Therefore all computer analysis was performed in Toronto (Downsview). The analysis runs were set up and executed by staff of the Planning Department with aid from personnel of the Municipal Planning Branch and The Systems Analysis Branch of the M.T.C.

Figure 4.1 is a generalized flow diagram of the activities performed during the computer analysis of the survey information. There are six major functions performed during the computer analysis.

1. The key punch cards are read onto tape and then SORTED into the three basic card types.

# FIGURE 4.1: SURVEY ANALYSIS PROCEDURES



2. Each card type is submitted to a series of EDIT checks;
3. The three record types are MERGED into one trip record file;
4. The survey information is subjected to a series of LOGIC checks;
5. The survey information is manipulated and analysed to produce STATISTICAL SUMMARIES that can be compared to similar summaries from other sources; and
6. The survey information is ANALYSED to produce the data summaries required for the traffic forecasting model validation and calibration.

## 4.2 PREPARATION OF SURVEY RECORDS

The first four steps outlined in the previous section actually involve the preparation of the coded survey information for the final two data anlysis stages. Before the final analysis can be performed the information must be checked for obvious errors and these errors corrected or eliminated. The information must also be manipulated from the form in which it was collected during the survey to a form that can be easily analysed with the computer programs available.

### 4.2.1. EDITING SURVEY DATA

The survey information,before it enters the computer, must be collected, coded and keypunched. At each of these steps there is the possibility of error. Each process was designed and carried out in such a manner as to minimize the possibility of error but it can never be eliminated completely.

The editing procedure was designed to check each record of the three record types for errors in coding, keypunching and information logic. The editing procedure finds all

obvious errors in the records and, where possible, corrects them. If the error is such that the correct information cannot be determined, the record was eliminated. If a record of any of the three types was eliminated, then all records of all types with the same sample number were eliminated.

The editing process was designed to answer the following questions:

a) Is the record number correct?

There are three separate and distinct record types containing the following types of information:

1. Household
2. Person
3. Trip

The record type is specified by the digit in the first entry of the record. To aid in the detection of errors, the records were sorted by record type using the IBM program SORT. The same program was used to sort the records or each record type into ascending order according to the appropriate combination of Sample, Person and Trip numbers. The three record types were then stored on three different tape files.

b) Are the numerical entries in each of the records within acceptable limits?

Each numerical coded entry on each of the record types should be within certain specified bounds of an upper and lower limit. The editing programs checked each field of each record type to be sure the records were acceptable. When an unacceptable entry was found, the entire record was printed

out. If the correct information could be easily identified the record was corrected. If the correct information could not be identified this record and all other records with a similar sample number were eliminated. This editing procedure was accomplished with the computer program ODRMNP which checked one record at a time and had allowances for a user subroutine to specify checks and manipulations.

c) Is the information logical?

The logic was checked between various entries on the same record. Since the three record types were separate, only information on the same record could be checked. For instance, on the trip record, the time of arrival had to be greater than the time of departure or the entry for numbers of passengers had to fit with the mode of travel. These preliminary logic checks were performed with the user subroutine of ODRMNP at the same time that the numerical limits were checked. Other logical checks were performed when the trip records were merged.

4.2.2. MERGING TRIP RECORDS

The information from the home interview O.D. survey was collected and coded in three distinct sections. These are:

1. Household information
2. Person information
3. Trip information

Each distinct information type was recorded on separate keypunch card types and then stored in three distinct and separate record files.

For the purpose of analysing the information it was necessary to have the information combined and stored on one file. Each merged file record contains information on the trip and the associated person and household. There is a merged record for every trip with the person information repeated on each trip record of the trips made by that person and household information repeated on each trip record made by persons that are members of that household.

The merging of the three record types into one required that a computer program be designed and written for this purpose. This program was prepared by the Systems Analysis Branch of M.T.C. The program read in 1402 Household Records, 4133 Person Records and 10209 Trip Records. In the merging process some trip records had to be created to accommodate information on persons who made no trips and had no trip records coded originally. Some records were dropped in an accompanying editing procedure. The final output was 10216 combined Trip Records. The information contained in the final trip record is shown in Figure 4.2.

4.2.3. CHECKS DURING MERGING

The three distinct record types (for any particular sample number) contain information that should check from one record type to another. Since the edit checks outlined earlier were done separately for each of the record types and on one record at a time, cross checks from one record type to another could not be performed. During the merging process all three record types enter the same program at the same time. This

# FIGURE 4.2: TRIP RECORD FORMAT

| ITEM | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | – | 39 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DESCRIPTION | ZONE OF HOUSEHOLD | SAMPLE NUMBER | PERSON NUMBER | TRIP NUMBER | TRAVELDATE | PERSON IDENTIFICATION | SEX | AGE | DRIVE AUTO | TRIPS MADE | PERSON INTERVIEWED | OCCUPATION | INDUSTRY | ZONE OF WORK LOCATION | PRIVATE OWNED AUTOS | COMPANY OWNED AUTOS | TRUCKS | TOTAL VEHICLES | PERMANENT RESIDENTS | PERMANENT RESIDENTS OVER 5 | TOTAL PERSON TRIPS | TOTAL VEHICLE DRIVER TRIPS | NO. OF PERSONS MAKING TRIPS | NO. OF PERSONS NOT MAKING TRIPS | ZONE OF ORIGIN | ZONE OF DESTINATION | PURPOSE FROM | PURPOSE TO | DEPARTURE TIME | ARRIVAL TIME | TRAVEL MODE | AUTO AVAILABILITY | CAR OCCUPANCY | TYPE OF PARKING | COST OF PARKING | RESIDENTIAL DENSITY INDICATOR | EMPLOYMENT DENSITY INDICATOR | PERSON TRIPS BY PERSON | | TRIP FACTOR |
| C.C | 1<br>2 3 | 4 5<br>6 7 | 8 | 9<br>10 | 11<br>12 13 | 14<br>15 | 16 | 17<br>18 | 19 | 20 | 21 | 22 | 23 | 24<br>25 26 | 27 | 28 | 29 | 30 | 31<br>32 | 33<br>34 | 35<br>36 | 37<br>38 | 39<br>40 | 41<br>42 | 43<br>44 45 | 46<br>47 48 | 49 | 50 | 51 52<br>53 54 | 55 56<br>57 58 | 59 | 60 | 61 | 62 | 63 64<br>65 66 67 | 68 | 69 | 70<br>71 | 72 73 74 75<br>76 77 78 79 | 80 |

CODES

ITEM 6: PERSON IDENTIFICATION

1. HOUSEHOLD HEAD
2. WIFE

10-19. CHILDREN
20-29. OTHER RELATIVES
30-39. UNRELATED PERSONS

ITEM 7: SEX

1. MALE
2. FEMALE

ITEM 9: DRIVE AUTO

1. YES
2. NO

ITEM 10: TRIPS MADE

1. YES
2. NO

ITEM 11: PERSON INTERVIEWED

1. YES
2. NO

ITEM 12: OCCUPATION

1. PROFESSIONAL & MANAGERIAL
2. CLERICAL & SALES
3. SERVICE
4. PRIMARY
5. LABOUR
6. UNEMPLOYED
7. OTHER

ITEM 13: INDUSTRY

1. PRIMARY
2. MANUFACTURING
3. SERVICE
4. WHOLESALE
5. RETAIL
6. CONSTRUCTION
7. UNEMPLOYED
8. OTHER

ITEM 27, 28: PURPOSE

| TO | FROM |
|---|---|
| 1. WORK | 1. |
| 2. SHOPPING | 2. |
| 3. SOCIAL | 3. |
| 4. RECREATION | 4. |
| 5. SCHOOL | 5. |
| 6. PERSONAL BUSINESS | 6. |
| 7. CHANGE TRAVEL MODE | 7. |
| 8. SERVE PASSENGER | 8. |
| 9. OTHER | 9. |
| 0. HOME | 0. |

ITEM 29, 30: ARRIVAL TIME, DEPARTURE TIME
24 HOUR CLOCK

ITEM 31: TRAVEL MODE

1. AUTO DRIVE
2. AUTO PASSENGER
3. TRANSIT
4. SCHOOL BUS
5. TAXI PASSENGER
6. TRUCK DRIVER
7. TRUCK PASSENGER
8. WALK
9. BICYCLE
0. MOTOR CYCLE

ITEM 32: AUTO AVAILABILITY

1. YES
2. NO

ITEM 35: PARKING COST
COLUMN 63 – CHARGES

1. HOURLY
2. DAILY
3. WEEKLY
4. MONTHLY

ITEM 36: RESIDENTIAL DENSITY INDICATOR

1. 0.1 TO 10.0 PERSON / ACRE
2. 10.1 TO 20.0 PERSON / ACRE
3. 20.1 TO 30.0 PERSON / ACRE
4. 30.1 TO 40.0 PERSON / ACRE
5. GREATER THAN 40.0 PERSON / ACRE

ITEM 37: EMPLOYMENT DENSITY INDICATOR

1. 0.0 TO 4.0 EMPLOYEES / ACRE
2. 4.1 TO 10.0 EMPLOYEES / ACRE
3. 10.1 TO 30.0 EMPLOYEES / ACRE
4. GREATER THAN 30.0 EMPLOYEES / ACRE

was an opportune time to carry out these additional edit checks.

Each individual sample household in the survey is identified by a distinct sample number. Any record of the three record types is identified with a distinct sample number. For each distinct sample number the following was checked:

1. There must be only one household record.
2. The number of person records should be numerically equal to the number of persons greater than 5 years of age entered in the household record.
3. The number of trip records should be numerically equal to the number of person trips entered in the household record.
4. The zone of home location coded on each of the record types should be numerically equal.
5. The number of vehicle trips on the household record is equal to the number of trip records of auto and truck driver made.

Each distinct person in a particular sample is identified by a person number, and a distinct person in the sample can be identified by a distinct combination of sample and person number. For each distinct combination of person number and sample number the following was checked:

1. There must be only one of the person record type.
2. Entries of similar data on person records and trip records must be identical.
3. If there is no trip record for a distinct combination of person number and sample number (for which there is a

household record and a person record) then a merged trip record is still required. This trip record contains all household and person data with the information normally obtained from the trip record left blank. Trips made are coded negative (2) for this type of record.

4.3 ADDITIONS TO THE TRIP RECORD FILE

During the merging of the three record types, the number of person trips was calculated for each distinct person in the sample. This trip information could not be added to the trip records during the merge process because of the way the program operated. Instead the information was stored on a separate file with the sample and person numbers as identifiers and then added to the trip record file later using the program ODRMNP. This data was put in columns 70 and 71 of each record.

It was necessary to identify each trip record in terms of the home zone, residential density and the work zone employment density, so that trip generation rates could be disaggregated by these densities. The residential densities and the employment densities were calculated for each zone in the study area. These densities were then categorized according to indicators. These density indicators were then added to the trip records (residential density indicator of home zone in column 68, employment density indicator in column 69) with the use of program ODRMNP.

4.4 FINAL TRIP RECORD FILE

The data used in the final analysis was as free from error as possible. However due to limitation in time the data

was not cleaned of all errors. The merge program specified, but was unable to correct some errors because of its operation limitations. These included a few discrepancies, between the total trips recorded for a household and the number of trip records on file for the household. The number of errors in the data was very small (less than 0.05 percent of all records) and was evenly distributed throughout the sample. The time required to develop a program to eliminate these errors would have been disproportionate to the returns achieved so the errors were left. This small number of errors proved to be an inconvenience later in the analysis procedures when totals of different stratification tables did not always match with each other but would differ by very small values.

## 4.5 ANALYSIS TECHNIQUES

The primary objective of the travel characteristics survey was to develop input information for the validation and calibration of the travel forecast model. However, before that information was developed it was necessary to obtain summaries of the data in a form that could be cross checked with information from other sources. These statistical summary checks were performed against data from Statistics Canada (Census) and summaries compiled from municipal assessment files.

The data analysis stage utilized two data summary computer programs available at the M.T.C. computer facilities. The first (AVGPSP) was used to create stratified cross classification tables. This program was capable of screening the trip records and cross classifying the data in terms of households,

persons or trips and any sub-category of each of these. This program was used to compile all tables required for statistical summary checks and input for calculating the travel characteristics summaries. The second program utilized was OVTRIP which was capable of building trip tables by purpose, mode or time of travel. This program was used to create the survey home based trip O.D. tables and P.M. peak hour total trip O.D. tables as well as a transit trip O.D. table. The O.D. tables, when analysed relative to travel times, were used to produce trip length frequencies by trip purpose.

4.5.1. CHECKS ON SURVEY ACCURACY

The data obtained in the travel characteristics survey had to be checked to ensure that it was a representative sample of all households in the study area. The method used to check the sample was to compile statistical summaries of the survey data concerning household and person information for the survey area and for municipal areas within the survey area and to then compare these to similar summaries compiled from an alternative source. The best alternative source of summaries of household and person characteristics is Census Canada which compiles their information from a sample including approximately 100% of all households.

The information summaries were used to check the following characteristics:

(a) the geographic distribution of households and population

(b) the age distribution of persons

(c) the size distribution of households

(d) the distribution of the labour force by occupation

(e) the distribution of the labour force by industry

(f) the labour participation rate of the population

These summaries when compared to other summaries indicate if the characteristics of our sample are similar to the characteristics of the population as a whole. If the characteristics differ, statistical techniques are employed to measure the degree of variance and to estimate the reliability of our sample.

4.5.2. DATA ANALYSIS

At this stage the trip record file was utilized to obtain information on person and household travel characteristics necessary for the calibration and validation of the travel forecast model. Additional data was obtained on the travel characteristics to compare with information from transportation studies conducted in the study area previously or from studies conducted in other areas.

The analysis involved obtaining the following information summaries in the manners described.

(1) Trip Length Frequency

The calibration of the trip distribution phase of the travel forecast model requires measures of the trip length frequencies by trip purpose. The computer program OVTRIP was utilized to obtain O.D. matrices from the survey sample by purpose at the traffic zone level. The interzonal travel times generated as the skim tree of a composite network simulation were then compared to these trip matrices to obtain

trip length frequencies for Home Based Work trips and for Other Home Based trips.

(2) Trip Generation Equations

The travel forecast model requires the input of P.M. peak hour home based work trip generation equations by residential and employment density indicators. These equations are available from the T.A.R.M.S. study but must be validated for the area or a new set of equations developed employing the same variables.

Instead of employing the regular regression analysis techniques against zonal aggregates each survey sample is used as an input as described in section 2.1. In effect, trip rates are established directly from the survey trip records. To obtain the trip production rate for P.M. peak hour home based work by residential density category AVGPSP was employed to create a cross classification of sample trips by residential density indicator of home zone, by purpose from, by purpose to, for only those trips that occurred in the P.M. peak hour.

Another table was created giving the total sample population by residential density at the home zone. To obtain the P.M. peak hour home based work trip production rate by residential density indicator, the home based work trips for a particular density indicator were divided by the sample population residing in zones of that same residential density indicator.

A similar process was employed at the trip attraction end. AVGSP was employed to produce a table of P.M. peak hour trips

by employment density indicator of work zone, by industry category, by purpose from, by purpose to. A table of persons by employment density indicator of work zone by industry category in which they are employed was created. The trip attraction rate for P.M. peak hour home based work trips is obtained by dividing the number of home based work trips from the first table by the number of persons employed in the second table for each combination of employment density category and industry category.

The form of the equations as established by the Toronto Area Regional Model Study (TARMS) is as follows:

Trips Produced = f (population)

Trips Attracted = f (retail employ, service and other employ, manufacturing and wholesale employ.)

There is one production equation for every residential density category and one attraction equation for every employment density category.

A similar process can be used to establish trip rates for any purpose over any time frame. Trip rates were established for 24 hour home based trips to be compared to similar data obtained by the TARMS study.

(3) Direction Split Factor

AVGPSP was used to establish a table of P.M. peak hour trips for purpose from, by purpose to. From this table it was established what percentage of the home based trips originated at the residential location and what percentage were destined to the residential location.

(4) Total Trip Factor

The total trip factor is used in the travel forecast model to convert travel demand within the P.M. peak hour for home based trips to total demand within the P.M. peak hour. AVGPSP was used to establish a cross classification table of purpose from by purpose to, for the P.M. peak hour. From this table are obtained the total sample P.M. peak hour person trips and the P.M. peak hour home based trips. The factor is established by dividing the first by the second.

# CHAPTER V
# SURVEY RESULTS

## 5.1 REPRESENTATIVENESS OF SURVEY DATA

The survey sample data was summarized in various forms and compared to summaries from other sources for the same area. The best alternative source of data for the area was the 1971 Census. The census information represented approximately 100% of the study area population and was assumed to be an accurate measure of the characteristics of all persons in the area.

The survey data summaries when compared to 1971 census summaries will illustrate any biases in the survey data.

Table 5.1 summarizes the final survey data following the editing and merging of the survey records. There are records of 1402 households with a total population of 4,435 of whom 4,133 are 5 years of age or over and, therefore, reported their trips. There was a minimal loss of survey data during editing procedures.

Table 5.2 shows the geographic representation of the sample data by the various municipalities within the study area. According to the data, the sample rate is slightly above average for Dundas and Flamborough East, while it is slightly below average for other rural municipalities.

TABLE 5.1

TRAVEL SURVEY RECORD SUMMARY

| RECORD TYPE | INFORMATION | NUMBER OF RECORDS |
|---|---|---|
| Household | Distinct H.H. Data | 1,402 |
| | H.H. with zero Trips | 178 |
| | H.H. with zero Autos | 248 |
| Person | Distinct Person Data (5+ Yrs.) | 4,133 |
| | Employed Full Time | 1,790 |
| | Male | 1,985 |
| | Female | 2,148 |
| | With Drivers Licence | 1,448 |
| Trips | Distinct Records | 10,216* |
| | Person Trips | 8,768 |
| | Vehicle Driver Trips | 5,074 |
| | Home Based Trips | 7,327 |
| | Home Based Work Trips | 2,838 |

* one record for every trip and one for every person not making a trip.

TABLE 5.2

GEOGRAPHIC DISTRIBUTION
OF SURVEY SAMPLE HOUSEHOLDS

| MUNICIPALITY | 1971 CENSUS HOUSEHOLDS | SAMPLE HOUSEHOLDS | PERCENT SAMPLE |
|---|---|---|---|
| Flamborough E | 2,189 | 25 | 1.142 |
| Flamborough W | 2,235 | 19 | 0.850 |
| Beverly | 1,645 | 14 | 0.851 |
| Ancaster | 3,999 | 32 | 0.800 |
| Glanbrook | 2,515 | 19 | 0.755 |
| Dundas | 4,933 | 51 | 1.115 |
| Stoney Creek | 7,563 | 73 | 0.965 |
| Burlington | 26,010 | 247 | 0.934 |
| Hamilton | 94,621 | 922 | 0.974 |
| TOTAL | 146,315 | 1,402 | 0.958 |

TABLE 5.3

AGE DISTRIBUTION OF SURVEY SAMPLE POPULATION

| AGE GROUP | 1971 CENSUS POPULATION HAMILTON (CMA) | SAMPLE POPULATION | PERCENT SAMPLE |
|---|---|---|---|
| 0 - 4 | 40,290 | 302 | 0.750 |
| 5 - 9 | 50,170 | 397 | 0.791 |
| 10 - 14 | 51,060 | 469 | 0.919 |
| 15 - 19 | 45,545 | 459 | 1.008 |
| 20 - 24 | 42,495 | 357 | 0.840 |
| 25 - 34 | 66,310 | 638 | 0.962 |
| 35 - 44 | 63,260 | 577 | 0.912 |
| 45 - 54 | 58,250 | 576 | 0.989 |
| 55 - 64 | 40,345 | 311 | 0.771 |
| 65 - 69 | 14,405 | 154 | 1.069 |
| 70+ | 26,405 | 195 | 0.738 |
| TOTAL | 498,525 | 4,435 | 0.890 |

Table 5.2 indicates that the survey sample represents 0.953 percent of all households in the study area. However, table 5.3 indicates that the sample population is only 0.890 percent of the total population for the study area. This suggests that there is some over-representation of smaller household sizes. Census data establishes the average household to contain 3.407 persons while the average for the survey sample is only 3.163 persons per household. Tables 5.4 and 5.5 illustrate this same point. The sample percentage of smaller households is above average while the sample percentage for large households is much below the average sample percentage. Table 5.3 further emphasizes this point with the below average sample size for persons in the younger age categories and the over-representation of persons in the category of 65 years and over.

This tendency of the sample to over-represent the smaller households has some impact on the representativeness of travel characteristics derived from the sample. Total trips per household calculated from the survey data might tend to be low while the total trip rate per person might tend to be slightly high. Since we are developing P.M. peak hour trip rates for only specific purposes, it was felt that no adjustment in the sample data was necessary.

TABLE 5.4

HOUSEHOLD SIZE DISTRIBUTION OF SURVEY SAMPLE HOUSEHOLDS

| PERSONS PER HOUSEHOLD | 1971 CENSUS HOUSEHOLDS HAMILTON CMA | SAMPLE HOUSEHOLDS | PERCENT SAMPLE |
|---|---|---|---|
| 1 | 18,395 | 198 | 1.076 |
| 2 | 38,395 | 397 | 1.034 |
| 3 | 26,150 | 232 | 0.887 |
| 4 | 28,520 | 299 | 1.048 |
| 5 | 18,245 | 169 | 0.926 |
| 6 | 9,400 | 64 | 0.680 |
| 7 | 4,435 | 32 | 0.722 |
| 8 | 1,555 | 7 | 0.450 |
| 9 | 735 | 2 | 0.272 |
| 10+ | 485 | 2 | 0.412 |
| TOTAL | 146,315 | 1,402 | 0.958 |

TABLE 5.5

HOUSEHOLD SIZE DISTRIBUTION OF SURVEY SAMPLE POPULATION

| PERSONS PER HOUSEHOLD | 1971 CENSUS POPULATION HAMILTON CMA | SAMPLE POPULATION | PERCENT SAMPLE |
|---|---|---|---|
| 1 | 18,395 | 198 | 1.076 |
| 2 | 76,790 | 794 | 1.034 |
| 3 | 78,450 | 696 | 0.887 |
| 4 | 114,080 | 1,196 | 1.048 |
| 5 | 91,225 | 845 | 0.926 |
| 6 | 56,400 | 384 | 0.680 |
| 7 | 31,045 | 224 | 0.722 |
| 8 | 12,440 | 56 | 0.450 |
| 9 | 6,615 | 18 | 0.272 |
| 10+ | 6,088 | 24 | 0.412 |
| TOTAL | 492,328 | 4,435 | 0.890 |

Information on the occupational and industrial distribution of those persons surveyed and in the labour force show a higher than average sample of the professional and managerial occupational categories. It is very unlikely that this reflects a true condition of the sample and can probably be explained by the possibility of errors in survey and coding techniques and the tendency of people to exaggerate their occupational importance.

TABLE 5.6

EMPLOYMENT DISTRIBUTION BY OCCUPATIONAL CATEGORY

| OCCUPATION | 1971 CENSUS LABOUR FORCE | SURVEY SAMPLE LABOUR FORCE | PERCENT SAMPLE |
|---|---|---|---|
| Professional & Managerial | 35,590 | 619 | 1.739 |
| Clerical & Sales | 56,015 | 355 | 0.634 |
| Service | 17,755 | 98 | 0.552 |
| Primary | 4,550 | 25 | 0.549 |
| Labour & Other | 80,605 | 704 | 0.873 |

Table 5.7 compares the survey sample of the labour force by industrial categories to a similar classification of 1971 census data on labour force for the same geographic area. This table shows a high percent sample in the service industries with a lower percent sample in the industries related to trade. However, the table suggests that the survey sample is fairly representative of the breakdown of labour force by industry categories to be used in the trip generation analysis.

TABLE 5.7

EMPLOYMENT DISTRIBUTION BY INDUSTRY CATEGORY

| INDUSTRY | 1971 CENSUS LABOUR FORCE | SURVEY SAMPLE LABOUR FORCE | PERCENT SAMPLE |
|---|---|---|---|
| Primary | 3,935 | 33 | 0.839 |
| Manufacturing | 73,300 | 675 | 0.921 |
| Construction | 13,390 | 99 | 0.739 |
| Service | 76,270 | 791 | 1.037 |
| Wholesale & Retail Trade | 32,200 | 199 | 0.618 |
| TOTAL | 199,095 | 1,790 | 0.899 |

The ratio of labour force to population calculated from survey data is 0.4061 employees per population. A similar ratio from 1971 census sources for the same geographic area is 0.3935 employees per population. This suggests that the employment ratio of the survey is slightly higher and the work trip generation rates would be slightly high.

Figure 5.1 summarizes the car ownership statistics from the survey sample. When compared to car ownership for the entire province the data shows an above average car ownership. The provincial average shows 1.16 autos per household while the survey suggests 1.20 autos per household in Hamilton. Table 5.8 shows the car ownership by family size within the survey sample.

## 5.2 TRAVEL DATA SUMMARY

The primary purpose of the survey was to obtain measures of the trip making and travel characteristics of the general public residing in the study area. The previous section reviewed the survey information to see how representative it is of the total population of the area. This section will summarize the survey data to give measures of travel characteristics.

Table 5.9 is a general summary of the travel characteristics obtained from the survey data. From the final 1402 survey households there were 8768 person trips generated. This gives an average of 6.254 person trips per household. This figure when compared to the TARMS figure of 5.30 trips per household for 1964 appears to represent an increase in trip making. Information from the "Hamilton Area Transportation Plan" compiled in 1961 gives an average of 6.2 person trips per household at

# FIGURE 5.1: CAR OWNERSHIP DISTRIBUTION

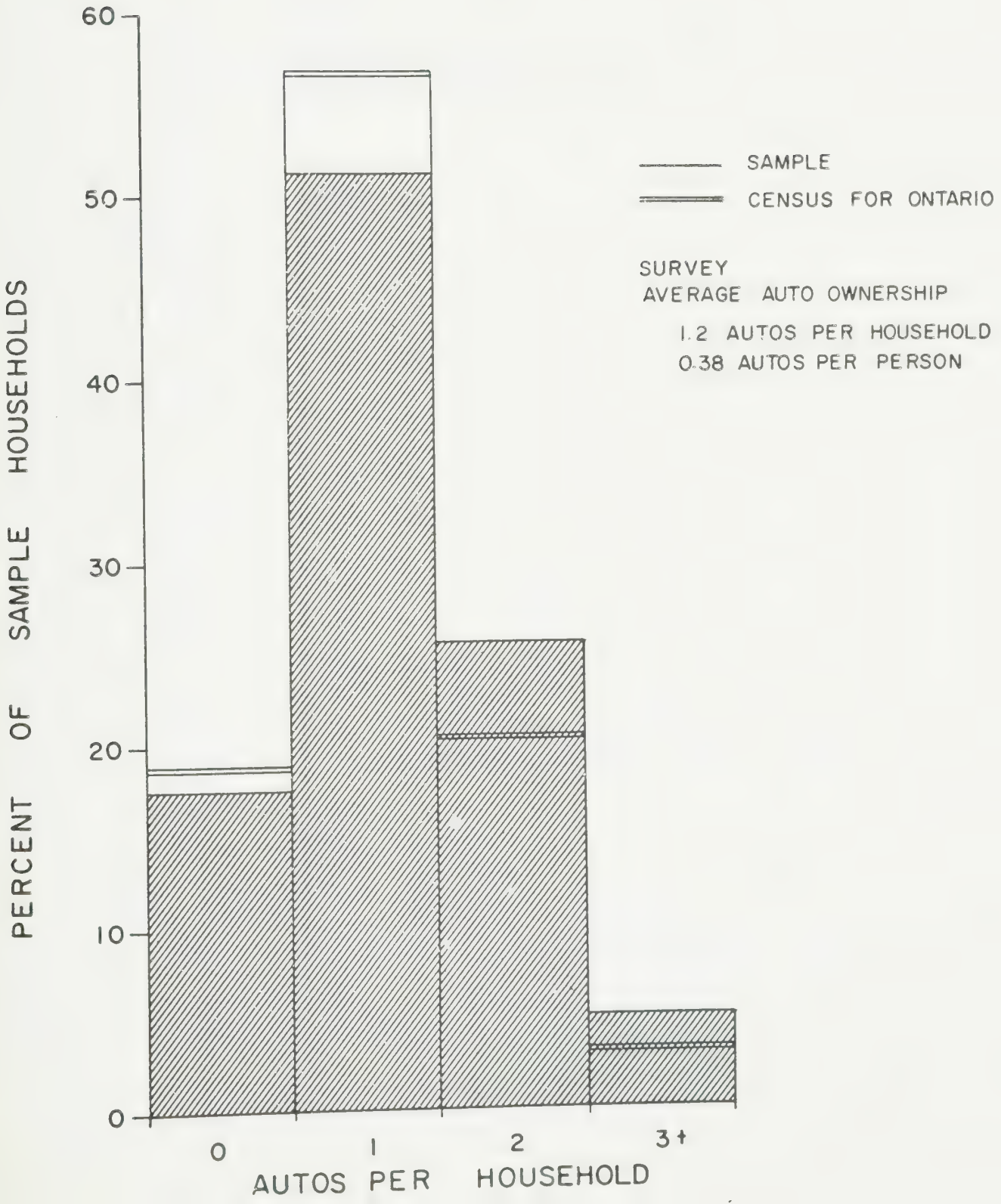


TABLE 5.8

HOUSEHOLD SIZE VERSUS CAR OWNERSHIP FOR SURVEY SAMPLE HOUSEHOLDS

| NUMBER OF HOUSEHOLD RESIDENTS | CAR OWNERSHIP 0 | 1 | 2 | 3 | 4 | 5 | TOTAL |
|---|---|---|---|---|---|---|---|
| 1 | 125 | 73 | 1 | 0 | 1 | 0 | 200 |
| 2 | 60 | 243 | 86 | 6 | 2 | 0 | 397 |
| 3 | 24 | 129 | 63 | 15 | 1 | 0 | 232 |
| 4 | 21 | 154 | 108 | 13 | 1 | 1 | 299 |
| 5 | 14 | 81 | 60 | 8 | 5 | 1 | 169 |
| 6 | 2 | 28 | 28 | 4 | 2 | 0 | 64 |
| 7 | 2 | 14 | 10 | 3 | 3 | | 32 |
| 8 | | | 5 | 1 | 0 | | 6 |
| 9 | | | 1 | | 1 | | 2 |
| 10+ | | | | | 1 | | 1 |
| TOTAL | 248 | 722 | 362 | 50 | 18 | 2 | 1,402 |
| NUMBER OF AUTOS | 0 | 722 | 724 | 150 | 72 | 10 | 1,678 |

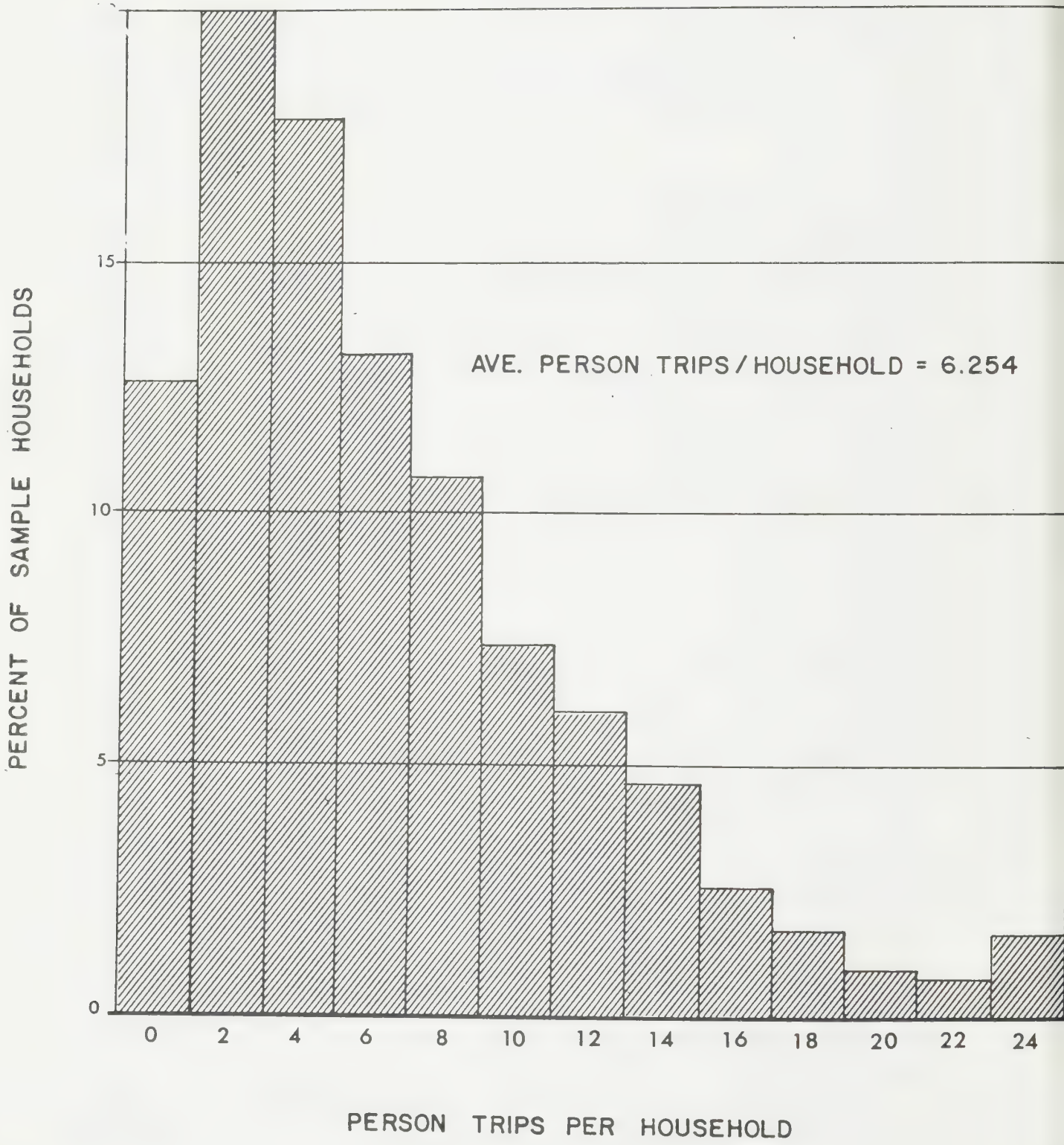
AVERAGE = 1.20 CARS PER FAMILY

TABLE 5.9

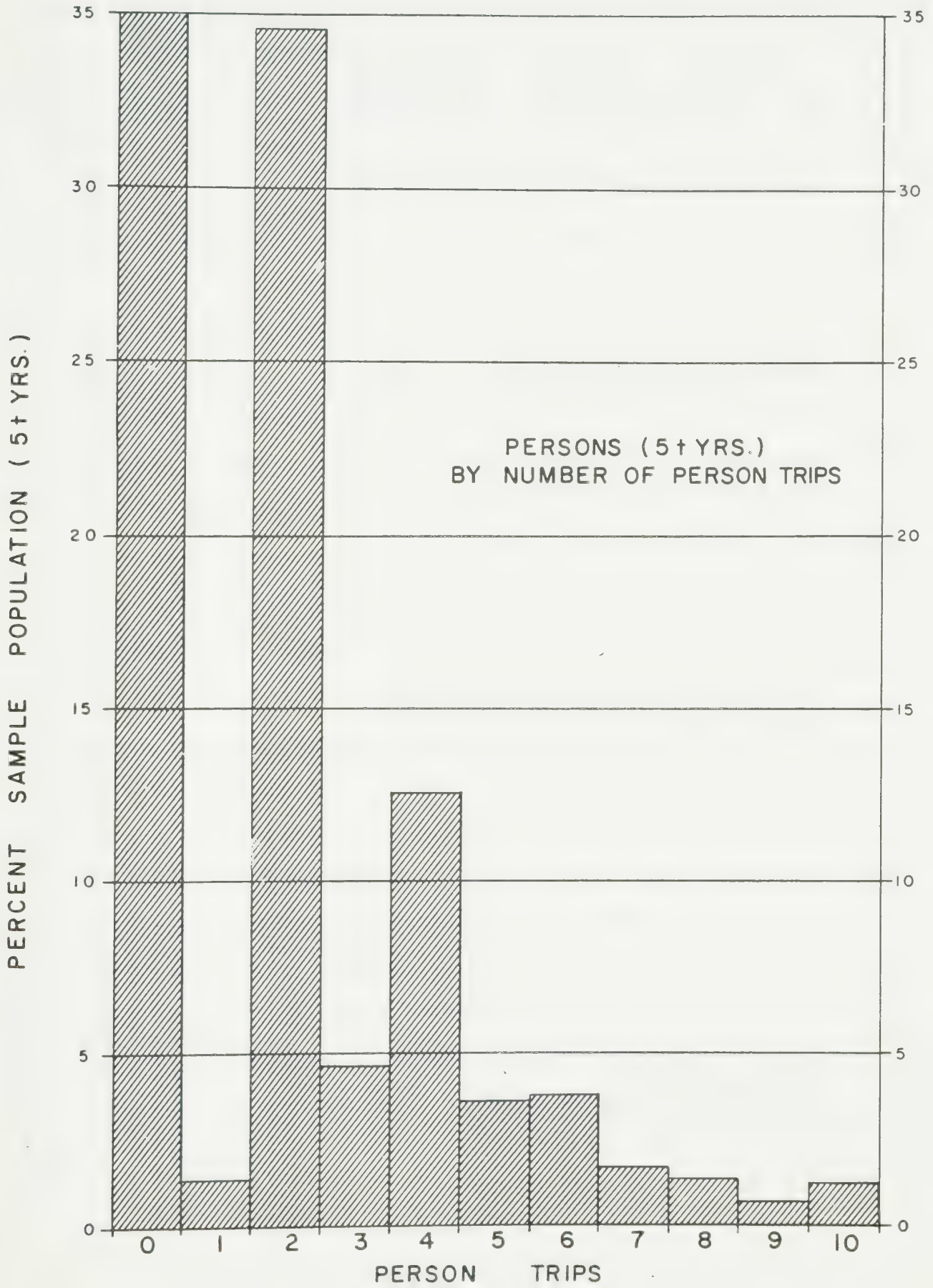
TRAVEL SURVEY INFORMATION SUMMARY

| ITEM | INFORMATION |
|---|---|
| Number of Households | 1,402 |
| H. H. With Zero Autos | 248 |
| H. H. With Zero Trips | 178 |
| Autos | 1,678 |
| Population (Total) | 4,435 |
| Population (5+ YRS) | 4,133 |
| Full Time Employees | 1,790 |
| Licenced Drivers | 2,175 |
| Persons With Zero Trips | 1,446 |
| Total Person Trips | 8,768 |
| Vehicle Driver Trips | 5,074 |
| Transit Trips | 1,024 |
| Persons/H. H. | 2.95 |
| Employees/H. H. | 1.28 |
| Autos/H. H. | 1.20 |
| Person Trips/H. H. | 6.254 |
| Vehicle Trips/H. H. | 3.61 |
| Percent H. H. With Zero Autos | 17.70% |
| Percent H. H. With Zero Trips | 12.70% |
| Labour Participation Rate | 0.40 |
| Autos/Person (Total) | 0.38 |
| Person Trips/Person (Total) | 1.98 |
| Vehicle Trips/Person (Total) | 1.40 |
| Percent Persons Not Making Trips | 34.98% |

# FIGURE 5.2: TRAVEL CHARACTERISTICS SURVEY
# PERSON TRIPS PER HOUSEHOLD



# FIGURE 5.3: TRAVEL CHARACTERISTICS SURVEY



that time in the city of Hamilton. This suggests that there has been little increase in trip making in the area. However, because the sample has a high proportion of smaller households, any trip rate compiled on a household basis will be unrepresentatively low. The trip making rate per household is further illustrated by figure 5.2 which shows that more than 55% of the surveyed households generate less than 6 person trips per day and 12.70 percent generate no trips.

Figure 5.3 shows the surveyed persons over 5 years of age by the number of person trips made in a 24 hour period. The survey data showed an average of 1.98 person trips per person (for the total survey population). When compared to the figure of 1.43 trips per person derived from TARMS 1964 survey it suggests that there has been an increase in trip making by individuals. The data on person trips shows that 35.98% of the survey persons over 5 years of age made no person trips in the 24 hour period.

It must be remembered, when interpreting the data on persons and households not making trips that no walk trips (except the first walk to work) were included in the survey. Therefore, most trips that do not extend out of the immediate neighbourhood were excluded. Table 5.10 shows that a large proportion of those persons not making trips were below 20 years of age or over 60 years of age. It was also found that a large majority of those persons not making trips did not belong to the labour force.

TABLE 5.10

PERSONS NOT MAKING TRIPS BY AGE CATEGORY

| AGE CATEGORY | PERSONS | PERSONS NOT MAKING TRIPS | PERCENT OF ROW | PERCENT OF COLUMN |
|---|---|---|---|---|
| 0.4 | — | — | — | — |
| 5.9 | 397 | 255 | 64.23 | 17.63 |
| 10.14 | 469 | 270 | 57.57 | 18.68 |
| 15.19 | 459 | 155 | 33.77 | 10.72 |
| 20.24 | 357 | 58 | 16.25 | 4.01 |
| 25.29 | 341 | 66 | 19.35 | 4.56 |
| 30.34 | 297 | 58 | 19.53 | 4.01 |
| 35.39 | 297 | 72 | 24.24 | 4.98 |
| 40.44 | 280 | 68 | 24.29 | 4.70 |
| 45.49 | 287 | 63 | 21.95 | 4.36 |
| 50.54 | 289 | 68 | 23.53 | 4.70 |
| 55.59 | 173 | 47 | 27.17 | 3.25 |
| 60.64 | 138 | 50 | 36.23 | 3.46 |
| 65.69 | 154 | 87 | 56.49 | 6.02 |
| 70+ | 195 | 129 | 66.15 | 8.92 |
| TOTAL | 4,133 | 1,446 | 34.99 | 100.00 |

Table 5.11 shows that 51.84 percent of the survey population has a drivers licence and is capable of operating a motor vehicle. Of the persons between the ages of 20 and 65 years, 76.23 percent are licenced to drive a motor vehicle. Over 82 percent of the surveyed households had an automobile at their disposal.

TABLE 5.11

TRAVEL CHARACTERISTICS SURVEY

PERSONS WITH DRIVERS LICENCE BY AGE CATEGORY

| GE GROUP | SAMPLE POPULATION | SAMPLE WITH DRIVERS LICENCE | PERCENT SAMPLE WITH LICENCE | PERCENT SAMPLE WITHOUT LICENCE |
|---|---|---|---|---|
| 0-4 | 302 | 0 | 0.00 | 100.00 |
| 5-9 | 397 | 0 | 0.00 | 100.00 |
| 10-14 | 469 | 0 | 0.00 | 100.00 |
| 15-19 | 459 | 164 | 13.94 | 86.06 |
| 20-24 | 357 | 259 | 72.55 | 27.45 |
| 25-34 | 638 | 532 | 83.39 | 16.61 |
| 35-44 | 577 | 452 | 78.34 | 21.66 |
| 45-54 | 576 | 426 | 73.96 | 26.04 |
| 55-64 | 311 | 204 | 65.59 | 34.41 |
| 65-69 | 154 | 76 | 49.35 | 50.65 |
| 70+ | 195 | 62 | 31.79 | 68.21 |
| TOTAL | 4,435 | 2,175 | 48.46 | 51.54 |

Transportation facilities are designed, constructed and operated to accommodate the maximum hourly traffic loads. The maximum demands for travel take place in two distinct periods of the day; one in the morning, the other in the afternoon. Figure 5.4 is a plot of the total surveyed person trips by the time of departure for the trip. The graph shows two distinct peak time periods where a large proportion of travel takes place.

The morning peak period extends from 7:00 a.m. to 9:00 a.m.; the afternoon peak period extends from 3:30 p.m. to 6:00 p.m. The actual afternoon peak hour occurs between 4:30 p.m. and 5:30 p.m. The P.M. peak hour contains approximately 11 percent of the 24 hour person trips and the A.M. peak hour contains slightly less than 10 percent of the 24 hour person trips.

The distribution of Home Based Work (HBW) trips by time of day is displayed in figure 5.5. The HBW trips have a similar distribution throughout the day to the total person trips with two distinct peaks occurring between 8:00 a.m. and 9:00 a.m. and 4:30 and 5:30 p.m. The peak periods are even more pronounced for the HBW trips with over 15% of the 24 hour trips occurring in each of the peak hours.

The morning peak consists mainly of trips from home to work and the afternoon peak is the opposite.

The series of smaller peaks illustrate the effects of shift operations in some of the manufacturing plants in the study area. A small number of workers are travelling from work to home between 7:00 a.m. and 9:00 a.m. Another small peak occurs about 3:00 p.m. with persons travelling to work. In the evening there is a small peak between 9:00 and 10:00 p.m. and another more pronounced peak between 11:00 and 12:00 midnight. The small peak around 12:00 noon is the effect of travel home at lunch time.

This graph shows that the shift operation of the manufacturing plants has very little impact on the demand for transportation facilities in the off peak periods. The impact

# FIGURE 5.4: TRAVEL CHARACTERISTICS SURVEY
# TRIP TIME DISTRIBUTION

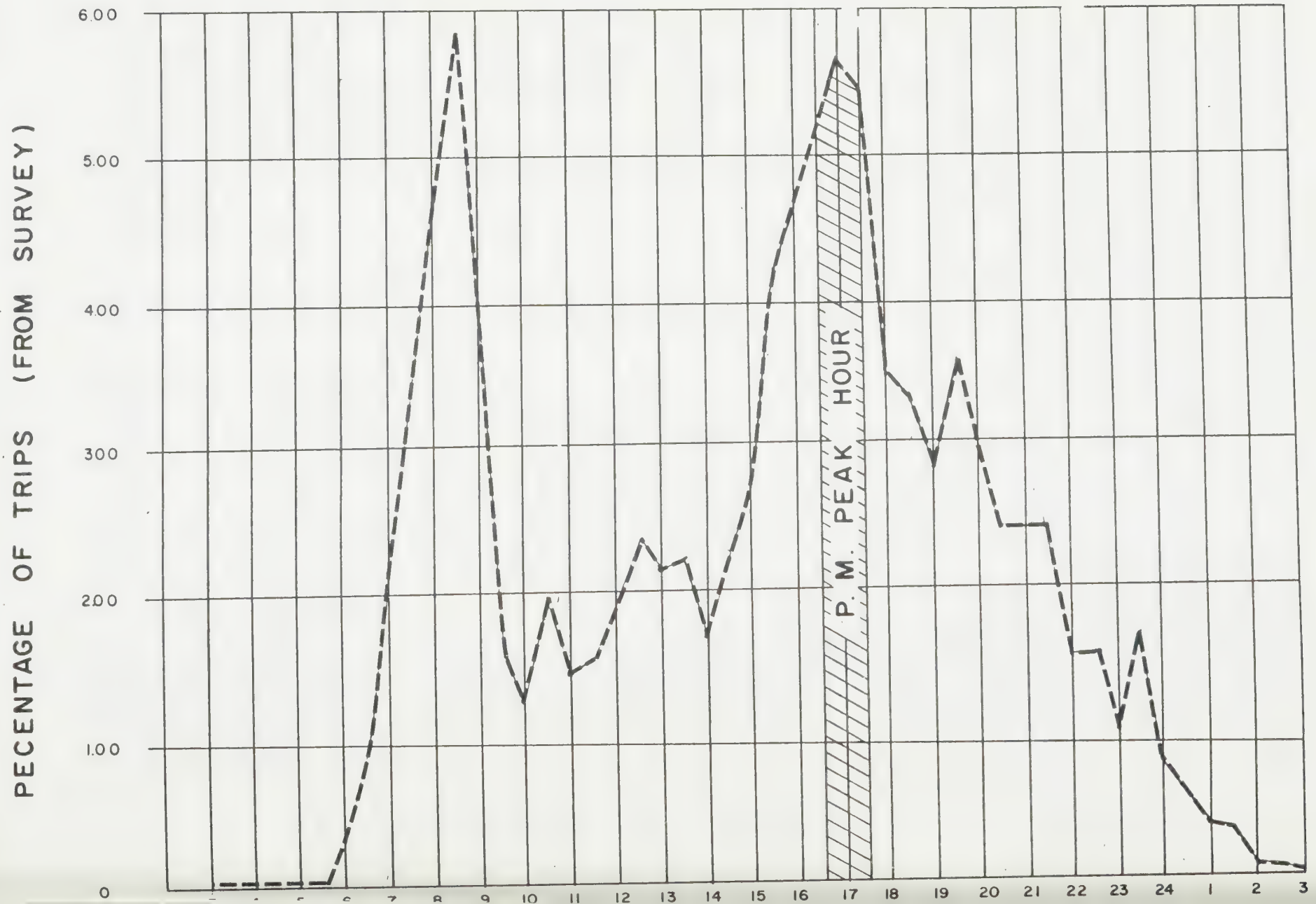
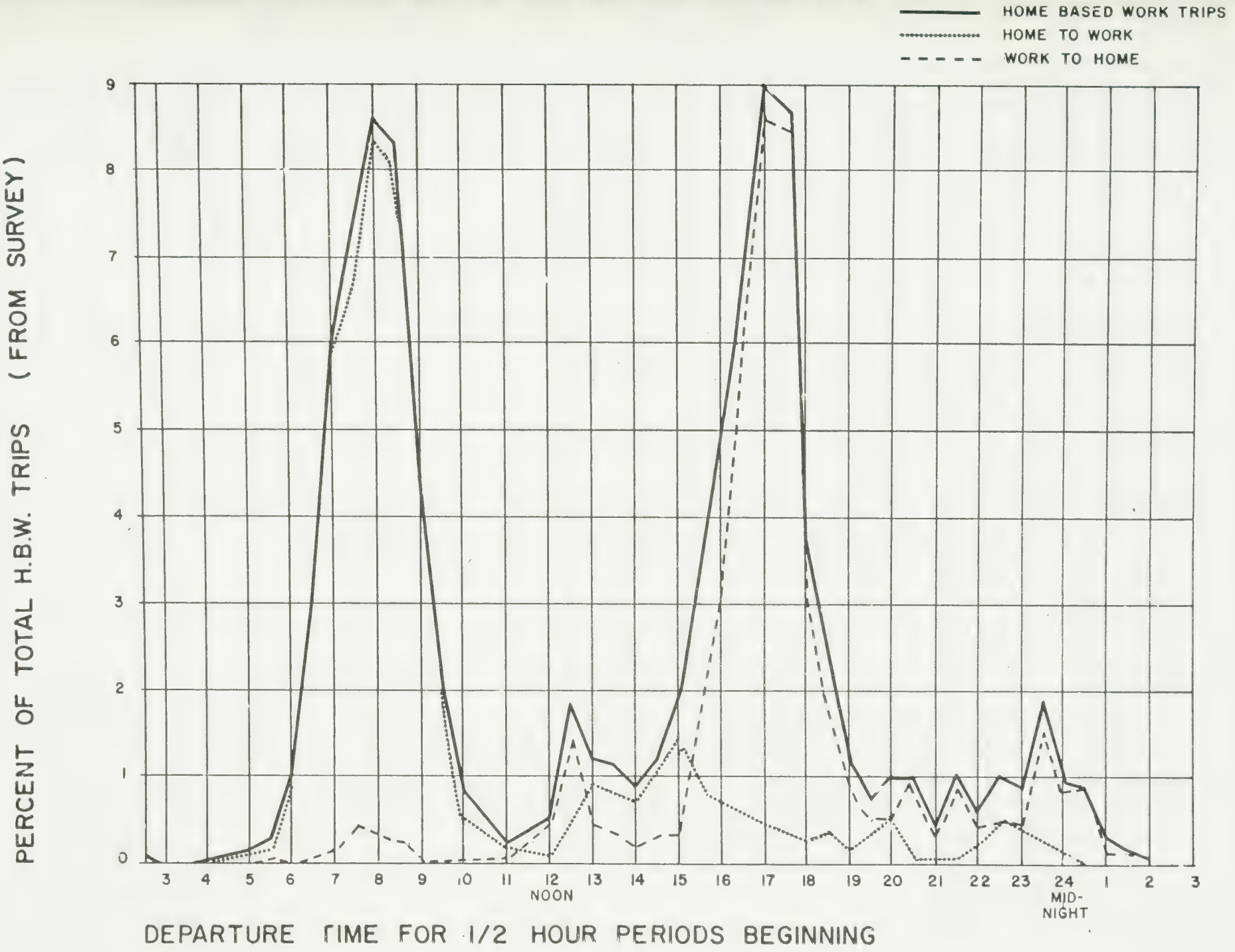


FIGURE 5.5 : H.B.W. TRIP TIME DISTRIBUTION



would be felt only in the immediate vicinity of the plants. The percentage of HBW trips occurring in the peak hours as a percentage of the total travel in the peak hour is smaller than for similar urban areas due to the off-peak Home Based Work travel resulting from shift work.

## 5.4 TRIP PURPOSE SUMMARY

Table 5.12 shows the number of person trips by purpose for a 24 hour week day period. Tables 5.13 and 5.14 show a summary of recorded trips by the major purposes for the 24 hour period and the peak hour period respectively. Figure 5.6 shows the percentage breakdown of these trips by purpose for the 24 hour period with a comparable breakdown compiled from the 1964 TARMS survey data. The Hamilton-Wentworth data shows a larger proportion of trips in the Home Based School and the Non-Home Based categories than does the TARMS data with a relatively lower proportion of trips in the other trip purpose categories.

Since only those trips requiring the use of some form of vehicle are recorded in the survey, the number of Home Based School trips would vary with the location of schools relative to the areas containing school age population. Primary schools are usually located so that the majority of students enrolled can walk to the school. The 1964 TARMS data summaries showed that an average of 45% of all secondary school trips were walk trips over the whole region of the study. However, the same source showed that only 26% of the secondary school trips in the city of Hamilton were walk trips. This statistic, along

# TABLE 5.12

PERSON TRIPS BY PURPOSE 24 HOUR

| DESTINATION PURPOSE | ORIGIN PURPOSE HOME | WORK | SHOPPING | SOCIAL | RECREATION | SCHOOL | PERSONAL BUSINESS | CHGE. TRVL. MODE | SERVE PASSENGER | OTHER | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|
| HOME | 0 | 1376 | 699 | 422 | 149 | 445 | 191 | 27 | 266 | 70 | 3645 |
| WORK | 1462 | 290 | 27 | 6 | 4 | 4 | 15 | 18 | 62 | 0 | 1888 |
| SHOPPING | 616 | 66 | 170 | 31 | 7 | 5 | 49 | 1 | 37 | 12 | 994 |
| SOCIAL | 364 | 32 | 42 | 59 | 8 | 9 | 17 | 4 | 33 | 4 | 572 |
| RECREATION | 147 | 4 | 8 | 6 | 6 | 9 | 4 | 0 | 6 | 3 | 193 |
| SCHOOL | 476 | 2 | 0 | 2 | 2 | 7 | 3 | 11 | 6 | 4 | 513 |
| PERSONAL BUSINESS | 209 | 31 | 19 | 10 | 2 | 4 | 23 | 0 | 12 | 0 | 310 |
| CHGE. TRVL. MODE | 33 | 17 | 0 | 1 | 0 | 9 | 0 | 5 | 0 | 1 | 66 |
| SERVE PASSENGER | 303 | 54 | 23 | 30 | 8 | 7 | 3 | 0 | 52 | 2 | 482 |
| OTHER | 72 | 4 | 4 | 2 | 5 | 4 | 3 | 0 | 2 | 9 | 105 |
| TOTAL | 3682 | 1876 | 992 | 569 | 191 | 503 | 308 | 66 | 476 | 105 | 8768 |

TABLE 5.13

TRIP GENERATION SUMMARY 24 HOUR

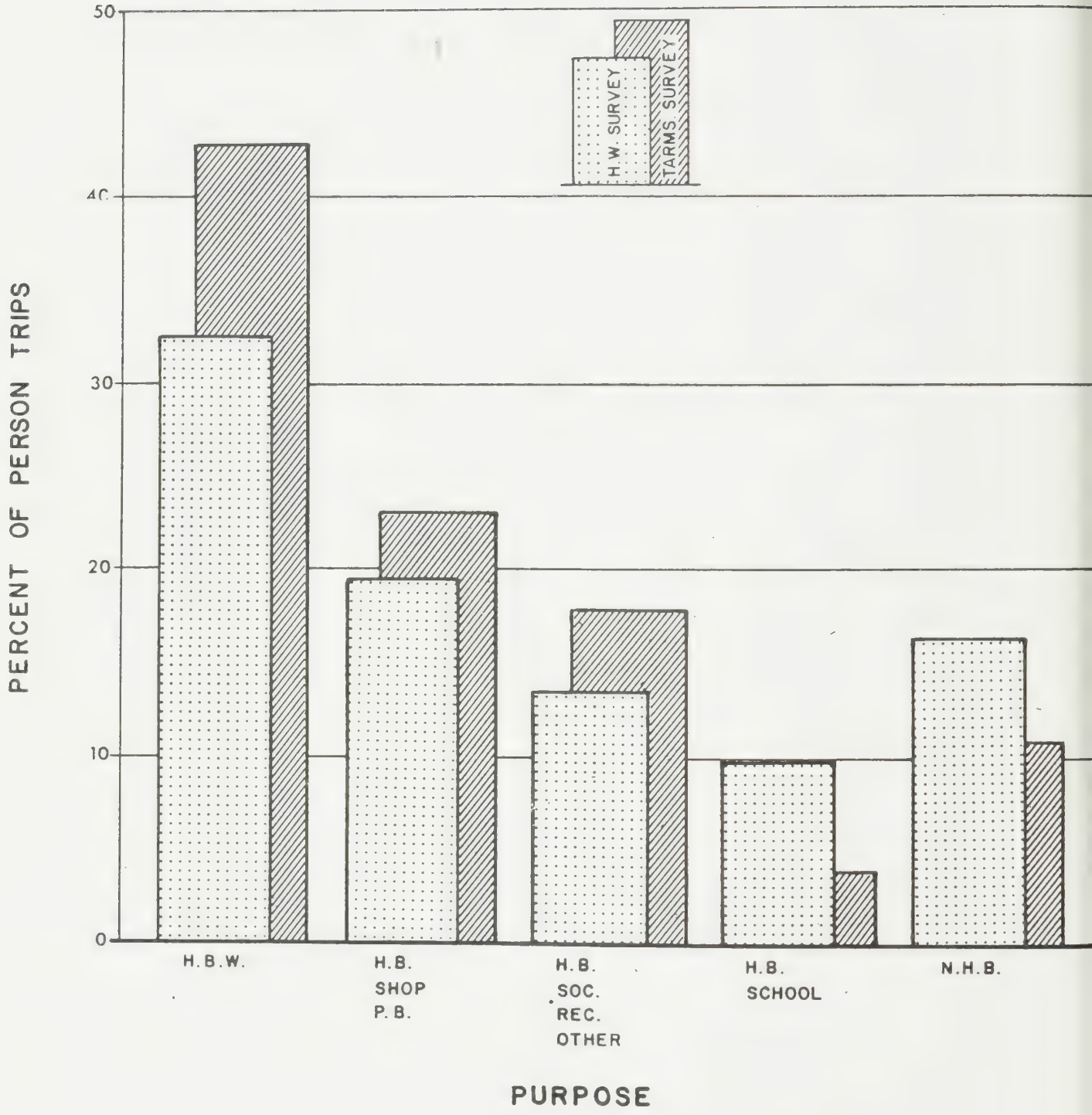
| ITEM | TOTAL | AVGE. TRIPS H.H. | AVGE. TRIPS PER PERSON TOTAL | 5+ YRS |
|---|---|---|---|---|
| Total Trip Records | 10,216 | | | |
| Total Person Trips | 8,768 | 6.255 | 1.961 | 2.122 |
| Vehicle Driver Trips | 5,226 | 3.619 | 1.135 | 1.228 |
| Vehicle Passenger Trips | 1,784 | 1.248 | 0.391 | 0.423 |
| Transit Trips | 1,026 | 0.732 | 0.229 | 0.248 |
| Other Modes | 732 | 0.522 | 0.165 | 0.177 |
| Home Based Trips | 7,327 | 5.226 | 1.638 | 1.773 |
| Home Based Work | 2,838 | 2.024 | 0.635 | 0.687 |
| H.B. Shopping & Personal Business | 1,715 | 1.223 | 0.383 | 0.415 |
| H.B. Social Recreation & Other | 1,224 | 0.873 | 0.273 | 0.296 |
| H.B. School | 868 | 0.619 | 0.196 | 0.210 |
| Non Home Based | 1,443 | 1.029 | 0.323 | 0.349 |
| Home to Work | 1,462 | 1.043 | 0.327 | 0.354 |
| Work to Home | 1,376 | 0.981 | 0.308 | 0.333 |

TABLE 5.14

TRIP GENERATION SUMMARY P.M. PEAK HOUR

| ITEM | TOTAL | AVGE. TRIPS/ H.H. | AVGE. TRIPS PER PERSON TOTAL | 5+ YRS |
|---|---|---|---|---|
| Total Person Trips | 1,158 | 0.826 | 0.259 | 0.280 |
| Vehicle Driver Trips | 752 | 0.512 | 0.162 | 0.17[illegible] |
| Vehicle Passenger Trips | 206 | 0.143 | 0.045 | 0.04[illegible] |
| Transit Trips | 138 | 0.098 | 0.031 | 0.03[illegible] |
| Other Modes | 62 | 0.044 | 0.014 | 0.015 |
| Home Based Trips | 997 | 0.711 | 0.223 | 0.241 |
| Home Based Work | 586 | 0.418 | 0.131 | 0.142 |
| H.B. Shopping & Personal Business | 193 | 0.138 | 0.043 | 0.047 |
| H.B. Social Recreation & Other | 84 | 0.060 | 0.019 | 0.020 |
| H.B. School | 46 | 0.033 | 0.010 | 0.011 |
| Non-Home Based | 161 | 0.115 | 0.036 | 0.039 |
| Home to Work | 33 | 0.024 | 0.007 | 0.008 |
| Work to Home | 553 | 0.394 | 0.124 | 0.134 |

# FIGURE 5.6: 24 HOUR PERSON TRIP RATE SUMMARY BY PURPOSE



with the presence of a major University and Community College shows agreement with the findings of this survey that home based school trips account for a larger percentage of the total 24 hour person trips in the Hamilton-Wentworth study area than they do in the larger TARMS study area.

Slightly over 16% of all 24 hour person trips from the survey were Non Home Based (NHB) trips. The fact that this percentage is higher than for the same trip purpose in the TARMS survey suggests that there are a larger number of dual purpose trips. Of the NHB trips over 60% have one end at the work location, with 20% of the NHB having both ends at the work location. Twenty-three percent of the NHB trips have both their start and end at the shopping, social and recreation purposes. The higher percentage of NHB trips means this trip purpose cannot be easily ignored when developing travel forecast models for detailed planning purposes. The high number of work oriented NHB trips suggest that trip linking should be investigated when analysing home based work trips.

A cursory examination of the effects of trip linking on the HBW trips in the Hamilton-Wentworth area showed a minimal effect on the overall production rates for this purpose. To obtain the true effect of dual purpose trips on HBW trips would require an extensive analytical procedure and the apparent change on the results would be minimal. It was decided that the NHB trips would have to be handled in the modelling procedures by factoring up the results of the simulation of Home Based trips.

The lower percentage of home based work trips in the Hamilton-Wentworth study area in comparison to the TARMS study is partially explained by the larger percentage of trips in the home based school and non-home based categories. However, there appears to be some real difference in the work trip making characteristics between the Hamilton-Wentworth area and the rest of the TARMS region. This is further suggested by work trip production rates developed for the different geographic areas covered by the 1964 survey. The data summaries from TARMS show an average home based work trip production rate for the entire TARMS area of 0.612 trips per person, while in the Hamilton-Wentworth area the average was only 0.582 trips per person. The 1974 survey shows the HBW trip production rate for a 24 hour period now stands at 0.635 trips per person.

The comparison of the 1974 survey data summaries to similar summaries derived from the 1964 TARMS survey suggests some basic differences in travel habits between the Hamilton-Wentworth study area and the larger TARMS study area encompassed by the 1964 survey. Because of the differences between geographic areas, it is difficult to obtain clear measures of change with time within the Hamilton-Wentworth study area. To achieve a comparison over time the survey results were compared to data summaries from a travel characteristics survey carried out in the city of Hamilton in 1961 for the Hamilton Area Transportation Plan. Although the 1961 survey covered only the city of Hamilton, it was the best data available for comparison purposes.

The survey summaries were compiled in a slightly different

manner for the 1961 study and required similar summaries from the 1974 survey for an accurate comparison. The trip purpose categories in the 1961 survey included one called "return home" which contains all travel ending at the home end no matter what the origin purpose. Table 5.15 compares the survey results by purpose for the 24 hour period and the P.M. peak hour respectively.

For the 24 hour period there appears to have been a slight increase in the percentage of trips for the shopping and other purpose category with an equivalent decrease in the percentage of trips for the purposes of business, social and recreation. These differences are small and could be explained by different procedures in classifying the trip purposes between the two studies. The comparison of trips by purpose occurring during the P.M. peak period shows negligible change in the time between the two surveys.

According to the comparisons with the 1961 survey in the city of Hamilton, there has been little change in the relative importance of the different trip purposes in the area. Other information from the 1961 survey shows the average person trip making rate, at that time, to be slightly over 6 trips per household which varies only slightly with the findings of this survey (6.26 trips per household). Therefore, there appears to be little change in the trip making rates per household for the various purposes over the 13 years between the two surveys. However, there has been a significant decrease in the average household size which implies an increase in the trip making rate per person.

TABLE 5.15

TRIP PURPOSE COMPARISON WITH 1961 H.A.T.S. SURVEY

| | PERCENTAGE OF TRIPS | | | |
|---|---|---|---|---|
| | 24 HOUR | | P.M. PEAK | |
| | 1974 | 1961 | 1974 | 1961 |
| Work | 21.53 | 21 | 4.80 | 3 |
| Business | 4.54 | 9 | 3.10 | 4 |
| Social & Recreation | 9.72 | 11 | 6.04 | 5 |
| Shopping | 11.34 | 9 | 8.38 | 9 |
| Other | 11.30 | 8 | 6.99 | 7 |
| Return Home | 41.57 | 42 | 70.70 | 72 |

5.5 TRIP END SUMMARIES

The Travel Characteristics Home Interview Survey produced data on 1402 households containing a total of 4435 persons and making a total of 8768 person trips. Table 5.13 shows the breakdown of the 24 hour person trips by major modes of travel and by trip purpose. The table summarizes trip generation rates on three bases: the household, total individuals and individuals over 5 years of age. Table 5.14 gives a similar breakdown for person trips occurring during the P.M. peak hour.

5.5.1. 24 HOUR TRIP END SUMMARY

The survey data summary shows the average 24 hour person trip rate to be 6.255 trips per household. This average figure is on the low side because of the over-representation of smaller households in the sample. The 1964 average trip rate calculated for the TARMS area was only 5.30 person trips per household and the 1961 HATS study gave an average trip rate of slightly over 6 person trips per household. The comparison with the 1961

figure suggests little change in the trip making rate per household but the bias of this sample toward smaller households could be hiding a slightly increased rate. The decrease in the average household size means an increase in the average trip making rate per person.

The 24 hour production rate for home based work trips is 2.024 trips per household. The TARMS study summarized HBW trip production rates with a rate of 2.14 trips per household for the Hamilton area. The 1961 survey for the HATS study gave a rate of approximately 2.15 trips per household. The decrease in the household production rate of HBW trips can be explained by the decrease in household size since the previous surveys and the bias of this survey sample toward smaller households. The TARMS 1964 data showed the HBW trip production rate for the Hamilton area to be lower than the average for the TARMS area which was 2.27 trips per household.

The survey summaries show the household trip rate for purposes of shopping and personal business to be 1.223 trips per household over a 24 hour period. The TARMS figure for the larger study area showed an average of 1.232 trips per household and the HATS study gave a comparable figure for the purpose of shopping and personal business. This shows little change in the trip making rate of shopping trips per household either on a geographic basis or over a time period.

The average trip rate for social, recreation and other purposes for the 24 hour period was 0.873 trips per household. The 1961 TARMS survey gave an average of 0.979 for the larger area but there were no figures available for comparison which

reflected the characteristics of only the Hamilton-Wentworth study area. The smaller trip rate can be explained by changes in family size as well as possible differences in geographic areas and changes in trip making characteristics over time. The rate of non-home based trips calculated from the survey data is twice the figure established for the TARMS area in 1964 and the average rate of home based school trips is considerably higher than the figure established in the previous study. This was expected since the analysis of trips by purpose in the previous section showed a higher percentage of trips in these two purposes than was shown in the TARMS survey summaries.

Table 5.13 also gives a summary of the average trip making rate per person over a 24 hour period. The survey gives the average number of person trips per person as 1.961. The TARMS data gave an average rate of 1.432 person trips per person over the larger geographic area. The average number of home based work trips per person as calculated from the survey is slightly higher than a similar figure of 0.616 calculated for the TARMS area. However the 1964 survey data was summarized for the geographic area of Hamilton and gave a lower rate of 0.582 HBW trips per person. The conclusion from this comparison is that the trip making rate for the purposes of work has increased on an individual basis over the 10 year time period. This is consistent with the increase in the labour participation rate which has occurred over this same period.

A further comparison between this survey and the TARMS

survey shows only a small increase in the trip making rate per person for home based trips concerned with shopping, personal business, social, recreation and other purposes. The trip rates per person for trips concerned with home based school and non-home based purposes calculated from this survey are approximately twice the values calculated from the TARMS survey data.

The determination of the home based work trip attraction rate per employee is a further check on trip making characteristics. This survey determined a rate of 1.585 trips per employee, exactly the same rate calculated from the TARMS data for the Hamilton - Burlington area. The rate for the larger TARMS area was slightly lower at 1.56 trips per employee.

5.5.2 P.M. PEAK HOUR TRIP END SUMMARY

Since the Transportation Sub-study traffic forecast model is to rely on a P.M. peak hour simulation, it is important that the peak hour data from the survey, used in establishing model parameters, be accurate. The summaries compiled for the peak hour from the survey data are compared where possible to similar data from other studies. Since a peak hour model has not been used extensively in previous studies concerned with the Hamilton area, there is limited information for comparison. The TARMS survey gives limited information on peak hour travel with none covering only the Hamilton area: other studies give no summaries on peak hour travel.

The survey shows that only 51% of the P.M. peak hour trips are home based work trips while the TARMS survey indicates that over 71% of the trips are for this purpose. This survey

indicates over 35% of the peak hour trips are home based trips for purposes other than work while TARMS shows only 22%. Furthermore, the TARMS figure of 7% of P.M. peak hour trips being non-home based is only half of the figure calculated n this survey.

The trip rates for P.M. peak hour when compared reflect some differences. The home based work trip rate for both studies show 0.13 trips per person. The trip rates for other home based trips occurring in the P.M. peak hour as calculated from this survey are approximately twice the rates established from the TARMS survey and the trip rate for non-home based trips is almost three times the value in the TARMS report.

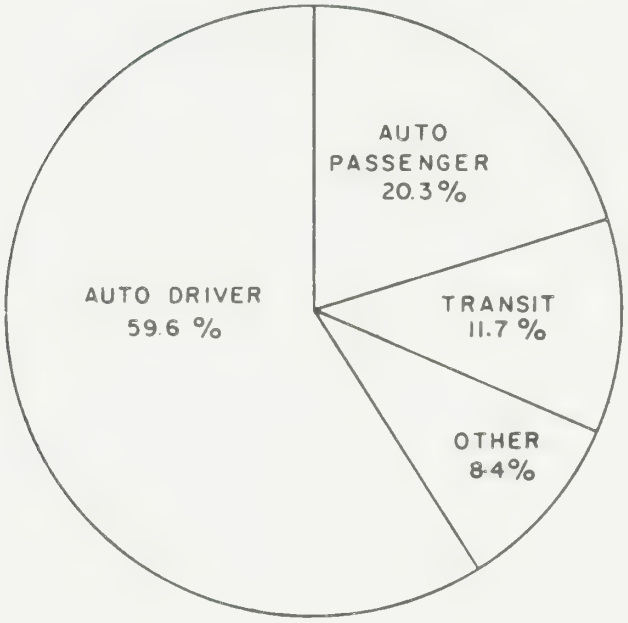
It can be concluded that the work trip production rates established in the TARMS study for the P.M. peak hour apply to the Hamilton study area and should be reliable through time. Further investigation will be carried out later in this chapter on P.M. peak hour home based work trip generation equations.

## 5.6 TRAVEL BY MODE

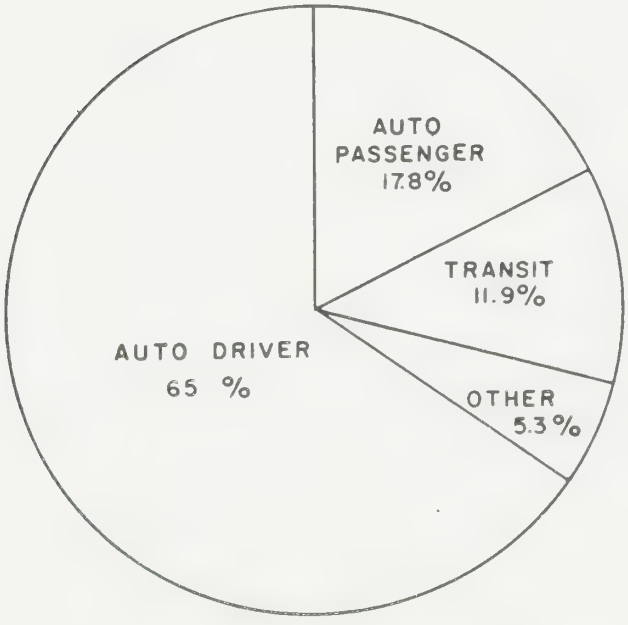
Figure 5.7 shows the survey travel data summarized by mode of travel for the survey data over a 24 hour period and for the P.M. peak hour period. For the 24 hour period, 59.6% of the travel is made by car drivers, 20.3% of the travel is as passengers in private automobiles and 11.7% is on public transit. The remaining 8.4% of the travel is using other modes of travel including school bus, taxis, motorcycle, bicycle and walk. Approximately 4% of the total travel is by school bus and 2.6% of the travel recorded was walk to work.

# FIGURE 5.7: 1974 CHARACTERISTICS SURVEY TRAVEL MODE SUMMARY

## 24 HOUR PERIOD




## P. M. PEAK HOUR PERIOD



In the P.M. peak hour the percentage of trips as vehicle driver increases to 65%, the percentage of auto passengers decreases to 17.8% and the percentage of transit riders remains approximately constant with 11.9% of the travel surveyed. The remaining 5.3% of the travel occurs with the use of other modes with the walk to work accounting for 3.5% of all survey trips occurring in the peak hour.

Although the survey sample was not large enough to make firm conclusions regarding details of transit ridership, the survey does provide evidence of the following. When compared to similar data compiled by the HATS study in 1961, a decline in the percentage of travel occurring by transit is evident. The HATS study shows the transit mode to have carried 17% of the 24 hour travel and 19% of the travel occurring in the P.M. peak hour. There has been an increase in the percentage of trips made by auto drivers with only 53% of the 24 hour travel made by auto in 1961 and 56% of the P.M. peak hour made by auto driver.

The TARMS survey summaries from 1964 give a modal breakdown of 59% auto driver, 23% auto passenger and 18% transit over a 24 hour period. This suggests that the modal usage in Hamilton for 1974 is quite different than the TARMS area in 1964 and that modal split relationships derived for the larger area have no guarantee of holding true for the Hamilton-Wentworth Region.

## 5.7 HOME BASED WORK TRIPS

### 5.7.1. TRIP GENERATION RATES

Two sets of trip generation rates were established from the survey data. One set was for 24 hour home based work trips, the other was for P.M. peak hour home based work trips. Each set contains trip production rates at the home end for each of five population density categories and trip attraction rates at the employment end for each of four employment density categories.

The 24 hour trip generation rates were developed for purposes of comparing with the trip generation equations developed for TARMS. The P.M. peak hour trip generation rates are required input for the travel forecast model. These rates were also compared with the equations established for TARMS for purposes of validation.

The trip generation rates established for the 24 hour HBW trips are shown in tables 5.16 and 5.17. Compared to similar equations developed for the TARMS study area (Appendix D), the trip production rates are quite similar except for the rate developed for the population density category of greater than 40.0 persons per acre. In this case, the discrepancy occurs partly because of the small sample in this density category and partly because of the characteristics of the only extensive high density neighbourhood in the study area. The only area to have an overall density greater than 40 persons per acre is the Durand neighbourhood in Hamilton. This neighbourhood has many high rise apartments and is close to the downtown area. The labour participation rate is above average and its close vicinity

to the downtown employment area would encourage people to go home for lunch.

TABLE 5.16

24 HOUR-HOME BASED WORK TRIP PRODUCTION RATES

| POPULATION PER ACRE | POPULATION | PERSON TRIPS | TRIPS PER PERSON |
|---|---|---|---|
| 0.1-10.0 | 1,612 | 963 | 0.597 |
| 10.1-20.0 | 1,857 | 1,236 | 0.666 |
| 20.1-30.0 | 547 | 328 | 0.600 |
| 30.1-40.0 | 382 | 242 | 0.634 |
| 40.0 | 85 | 69 | 0.812 |

TABLE 5.17

24 HOUR-HOME BASED WORK TRIP ATTRACTION RATES

| TOTAL EMPLOYMENT PER ACRE | INDUSTRY | EMPLOYEES | H.B.W.T. | TRIPS PER EMPLOYEE |
|---|---|---|---|---|
| 0.1 - 4.0 | Manufacturing & Wholesale | 300 | 510 | 1.700 |
| | Retail | 114 | 168 | 1.474 |
| | Service & Other | 448 | 666 | 1.487 |
| | TOTAL | 862 | 1,346 | 1.561 |
| 4.1 - 10.0 | Manufacturing & Wholesale | 104 | 169 | 1.625 |
| | Retail | 18 | 29 | 1.611 |
| | Service & Other | 172 | 246 | 1.430 |
| | TOTAL | 284 | 448 | 1.577 |
| 10.1 - 30.0 | Manufacturing & Wholesale | 233 | 353 | 1.515 |
| | Retail | 28 | 35 | 1.250 |
| | Service & Other | 168 | 273 | 1.625 |
| | TOTAL | 429 | 663 | 1.545 |
| >30.0 | Manufacturing & Wholesale | 139 | 209 | 1.504 |
| | Retail | 22 | 37 | 1.682 |
| | Service & Other | 65 | 102 | 1.569 |
| | TOTAL | 226 | 348 | 1.540 |

When comparing the HBW trip production rates, the coefficients of the original TARMS trip production equations (Appendix D) were adjusted by a value of C. The value of C is equivalent to the ratio of the average labour participation rate for the Hamilton-Wentworth study area in 1974 to the average labour participation rate for the TARMS area in 1964. The value of C for purposes of this comparison was 1.02.

The 24 hour HBW trip attraction equations compare less favourably with the TARMS equations. The rates for Manufacturing and Wholesale employment are similar with the same decrease in attraction for increase in density category. However, the rates for the other industry categories do not agree as closely. The equations or rates established for the two different surveys were done using two different techniques. The TARMS equations were developed using regression analysis on zonal aggregates of trip data compared to zonal totals for land use obtained from a source outside the survey. The rates established for this study were developed as simple rates using each record as input data with data on industry type and density of employment established from the survey records.

The trip attraction rates established by this study use the survey records disaggregated by industry type of employment and employment density of the zone of work location. For this reason the sample size on which each of these rates is established is very small and the trip attraction rates are questionable. Since the work trip attraction rate per employee is identical for both surveys and since the work trip production

TABLE 5 .18

P.M. PEAK HOUR-HOME BASED WORK TRIP PRODUCTION RATES

| POPULATION PER ACRE | POPULATION | PERSON TRIPS | TRIPS PER PERSON |
|---|---|---|---|
| 0.1 - 10.0 | 1,612 | 192 | 0.119 |
| 10.1 - 20.0 | 1,857 | 252 | 0.136 |
| 20.1 - 30.0 | 547 | 76 | 0.139 |
| 30.1 - 40.0 | 382 | 50 | 0.131 |
| 40.0 | 85 | 16 | 0.188 |

TABLE 5 .19

P.M. PEAK HOUR-HOME BASED WORK TRIP ATTRACTION RATES

| TOTAL EMPLOYMENT PER ACRE | INDUSTRY | EMPLOYEES | H.B.W.T. | TRIPS PER EMPLOYEE |
|---|---|---|---|---|
| 0.1 - 4.0 | Manufacturing & Wholesale | 300 | 109 | 0.363 |
| | Retail | 114 | 36 | 0.315 |
| | Service & Other | 448 | 154 | 0.347 |
| | TOTAL | 862 | 299 | 0.347 |
| 4.1 - 10.0 | Manufacturing & Wholesale | 104 | 36 | 0.346 |
| | Retail | 18 | 7 | 0.389 |
| | Service & Other | 172 | 48 | 0.279 |
| | TOTAL | 284 | 91 | 0.320 |
| 10.1 - 30.0 | Manufacturing & Wholesale | 233 | 60 | 0.258 |
| | Retail | 28 | 8 | 0.288 |
| | Service & Other | 168 | 61 | 0.363 |
| | TOTAL | 429 | 129 | 0.301 |
| >30.0 | Manufacturing & Wholesale | 139 | 24 | 0.173 |
| | Retail | 22 | 11 | 0.500 |
| | Service & | | | |

rates are similar, it was decided that the home based work trip attractions equations established from the TARMS data should be used.

The trip generation rates established from this survey data for the P.M. peak hour home based work trips are shown in tables 5.18 and 5.19. These rates can be compared to similar equations established for the TARMS area in 1964 (Appendix D). The trip production rates are consistent with those from the TARMS survey with the exception of that for the highest residential density category. Again this reflects the characteristics of Hamilton's only high density neighbourhood. Again the comparison of the trip attraction rates is less favourable for the same reasons specified previously.

Since the disaggregation of a small sample into even smaller sub-sections was necessary to calculate the trip attraction rates and because some of the rates were established on a very small sample, it was decided that the TARMS attraction equations should be used for P.M. peak hour HBW trips. The final equations to be used in the travel forecast model are shown in table 5.20.

TABLE 5.20

P.M. PEAK HOUR-HOME BASED WORK TRIP GENERATION RATES

PRODUCTIONS

| POPULATION PER ACRE | | INDEMENDENT VARIABLES POPULATION |
|---|---|---|
| 0.1 | 10.0 | C x 0.119 |
| 10.1 | 20.0 | C x 0.136 |
| 20.1 | 30.0 | C x 0.139 |
| 30.1 | 40.0 | C x 0.131 |
| > | 40.0 | C x 0.188 |

ATTRACTIONS

| EMPLOYMENT PER ACRE | MANUFACTURE & WHOLESALE EMPLOY. | INDEPENDENT VARIABLES RETAIL EMPLOY. | SERVICE & OTHER EMPLOY. |
|---|---|---|---|
| 0.1- 4.0 | 0.330 | 0.309 | 0.309 |
| 4.1-10.0 | 0.318 | 0.308 | 0.308 |
| 10.1-30.0 | 0.307 | 0.272 | 0.314 |
| > 30.0 | 0.343 | 0.218 | 0.405 |

## 5.7.2 TRIP LENGTH FREQUENCY

One of the dominant characteristics of travel is the distance or time that people will travel for any trip purpose. The Home Based Work trips have been analysed relative to their travel time and the results are shown in figures 5.8 and 5.9. The first graph is a plot of the percentage of trips that have a travel time equivalent to the increment shown, the second graph shows the cumulative percentage of trips with a travel time less than on the abscissa. The mean travel time in the study area for purposes of travel from home to work or vice versa is 15.5 minutes. The Hamilton Area Transportation Study conducted in 1961 found the mean travel time for HBW trips to be approximately 11 minutes. This shows a definite increase in acceptable travel times as the urban area increases in size.

# FIGURE 5.8: TRIP LENGTH FREQUENCY DISTRIBUTION
## HOME BASED WORK

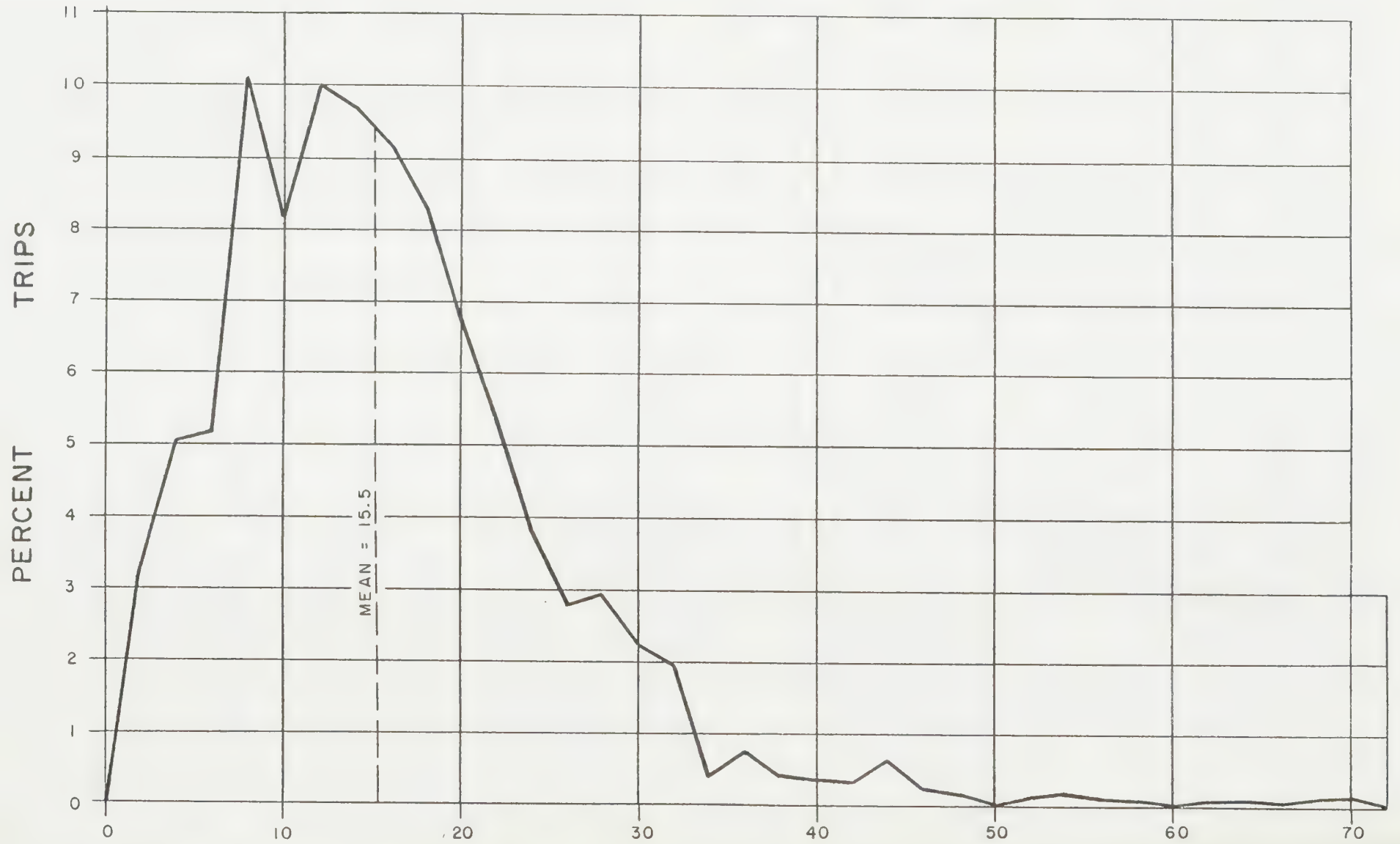
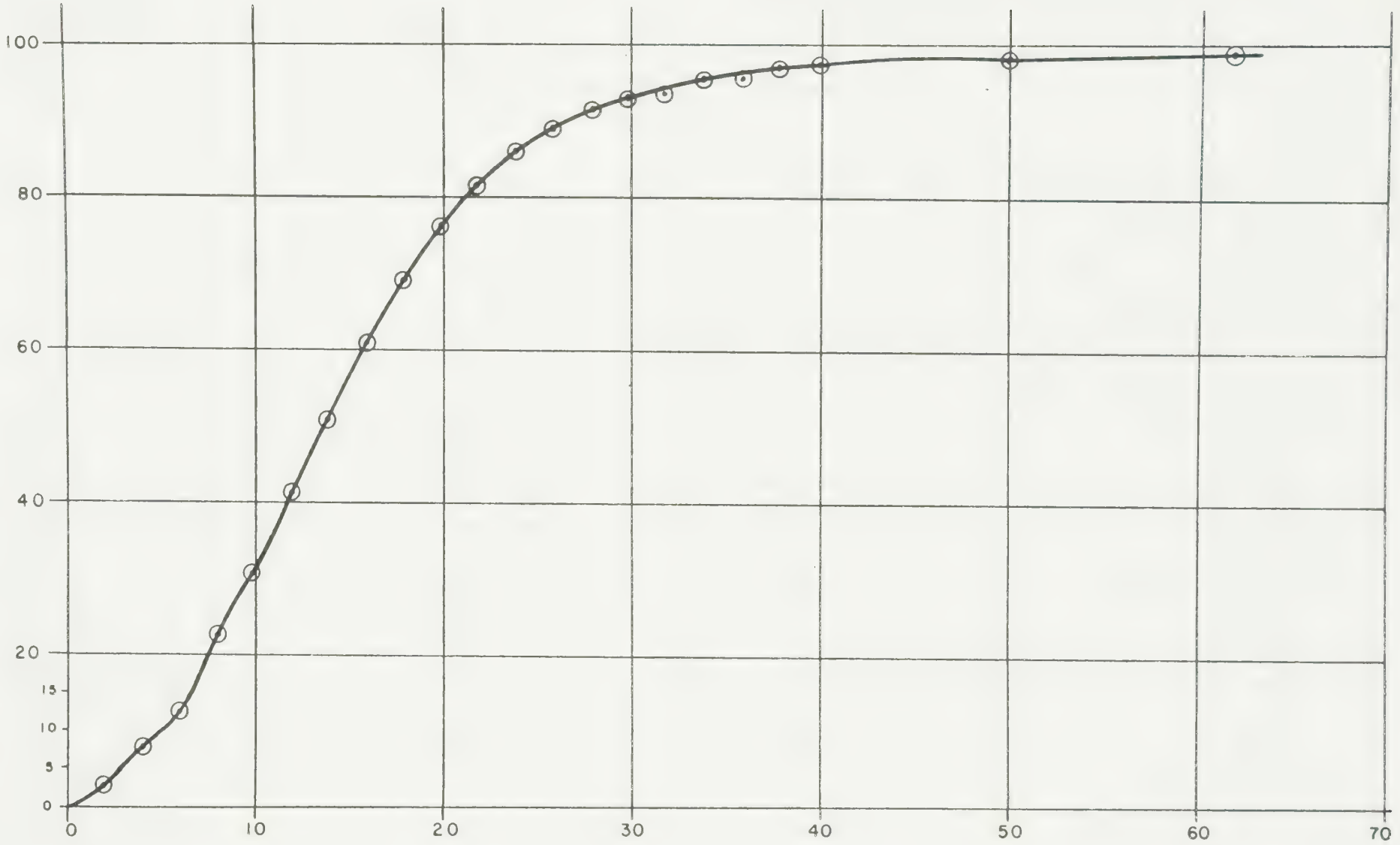


FIGURE 5.9: COMMULATIVE TRIP LENGTH FREQUENCY
HOME BASED WORK TRIPS



## 5.8 OTHER HOME BASED TRIPS

Data from the survey shows that home based work trips account for only 51 percent of all person trips occurring in the P.M. peak hour. Home based trips for purposes other than work account for an additional 36 percent of trips occurring in the P.M. peak hour. These home based trips include the purposes of shopping, personal business, social, recreation, school and other. In order to keep the modelling procedure simple, it would be undesirable to develop a set of trip generation equations for each of these purposes. None of these purposes when modelled in conjunction with home based work trips would account for a large enough proportion of P.M. peak hour travel. Home based shopping and personal business trips when combined account for only an additional 16 percent of P.M. peak hour person travel.

It was decided to develop one set of trip generation equations for all home based trips for purposes other than work. These shall be referred to in this text as Home Based Other (HBO) trips. With the simulation of HBO trips in addition to the HBW trips, the traffic simulation model will account for 87 percent of person travel in the P.M. peak hour.

### 5.8.1. TRIP GENERATION EQUATIONS

The small sample survey data is a sufficient base for developing trip production equations if each trip record is used as input rather than using factored zonal aggregates of the trip records. However, when developing trip attraction equations for the HBO purpose, the survey contains no information

that ties the non-home trip end to land use information. It is therefore not possible to develop trip attraction equations for HBO trips from this survey data. Instead, previous travel surveys for the area were investigated and a suitable trip attraction equation was adopted.

The trip production rate for HBO trips was established in a similar manner to the production rate for HBW trips. The information was disaggregated by residential density categories and a trip rate was established for each density category. Both 24 hour and P.M. peak hour trip rates were established. The calculated rates are shown in table 5.21. Information from previous studies suggests that the HBO trips are best expressed as a function of dwelling units, families or households rather than population.

TABLE 5.21

HOME BASED OTHER TRIPS

| RESIDENTIAL DENSITY (Population/Acre) | TRIP PRODUCTION RATE PER HOUSEHOLD 24 HOUR | P.M. PEAK HOUR |
|---|---|---|
| 0.1 to 10.0 | 4.283 | 0.370 |
| 10.1 to 20.0 | 2.960 | 0.283 |
| 20.1 to 30.0 | 2.445 | 0.217 |
| 30.1 to 40.0 | 2.032 | 0.176 |
| > 40.0 | 1.275 | 0.157 |

The TARMS study developed no trip production information for a trip purpose category as described here. The HATS study survey information suggests an average of 3.2 trips per family over a 24 hour period. The trip production rates in table 5.21 show that the rate diminishes as the residential density increases.

The rates to be used in the simulation model are the P.M. peak hour rates for each of the five density categories.

Trip attraction equations or rates cannot be developed from the survey data. The TARMS survey summaries showed a significant variation in trip production rates for the non work home based trips between urban areas within the larger study area and the TARMS study did not develop equations for HBO trips as defined in this section.

The HATS survey data when compared to this survey suggest very little change in the importance of the different trip purposes in the Hamilton area between 1961 and 1974. In fact, comparison showed a similar breakdown of trips by purpose in both the 24 hour and the P.M. peak hour periods. The average trip generation per household showed little variation between the two studies. Although the HATS study did not develop a trip generation equation for what we have defined as HBO trips, the survey did establish the type of land use at the trip ends for each trip purpose. Assuming that their findings in this area hold constant through time and that the distribution is representative of both 24 hour periods and peak periods, this information can be utilized in establishing HBO trip attraction information.

Table 5.22 illustrates the types of land use reported at the non home end of HBO trips. This shows that 61 percent of the trips are attracted to retail and service categories of land use. Trips to this land use category would include shopping and some social and recreation trips. The twenty-six

percent of travel attracted to residential land use would include social and recreation trips to visit frients at their place of residence. Trips to other land use categories include recreation trips to open space and recreation areas such as the Botanical Gardens.

TABLE 5.22

HOME BASED OTHER TRIPS
LAND USE AS A TRIP ATTRACTOR

| LAND USE AT DESTINATION | PERCENT OF TRIPS |
|---|---|
| Manufacturing | 2.0 |
| Retail & Service | 61.0 |
| Residential | 26.0 |
| Other | 11.0 |

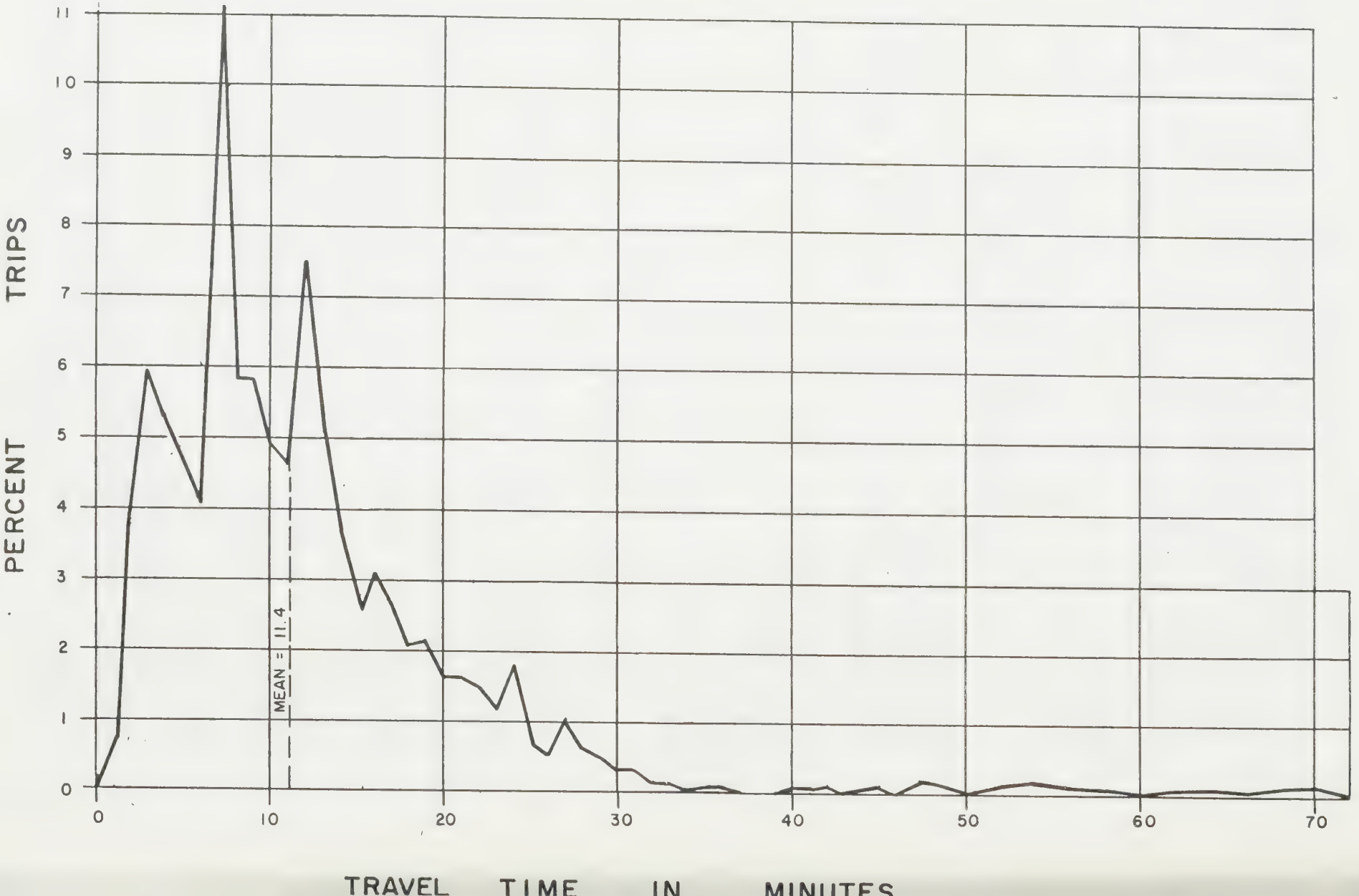
Source: Hamilton Area Transportation Plan
C. C. Parker & Parsons, Brinkerhoff Ltd., May, 1963

The total trip productions once established will be attracted to the different land uses proportionately to the values shown in table 5.22. Since sixty-one percent of all home based other trips will go to retail and service land uses, sixty-one percent of the production value will be distributed proportionately employment. A similar method will be used to establish the values of zonal attraction for each of the other land use categories.

5.8.2. TRIP LENGTH FREQUENCY

The Home Based Other trips have been analysed relative to the length of time of travel and the results appear in figures

# FIGURE 5.10: TRIP LENGTH FREQUENCY DISTRIBUTION
# OTHER HOME BASED



5.10 and 5.11. The first graph is a plot of the percentage of HBO trips with a trip travel time equivalent to the value shown on the abscissa, the second graph shows the cumulative percentage of HBO trips with a travel time less than the value shown on the abscissa. The mean one way travel time for home based trips for purposes other than work is 11.4 minutes.

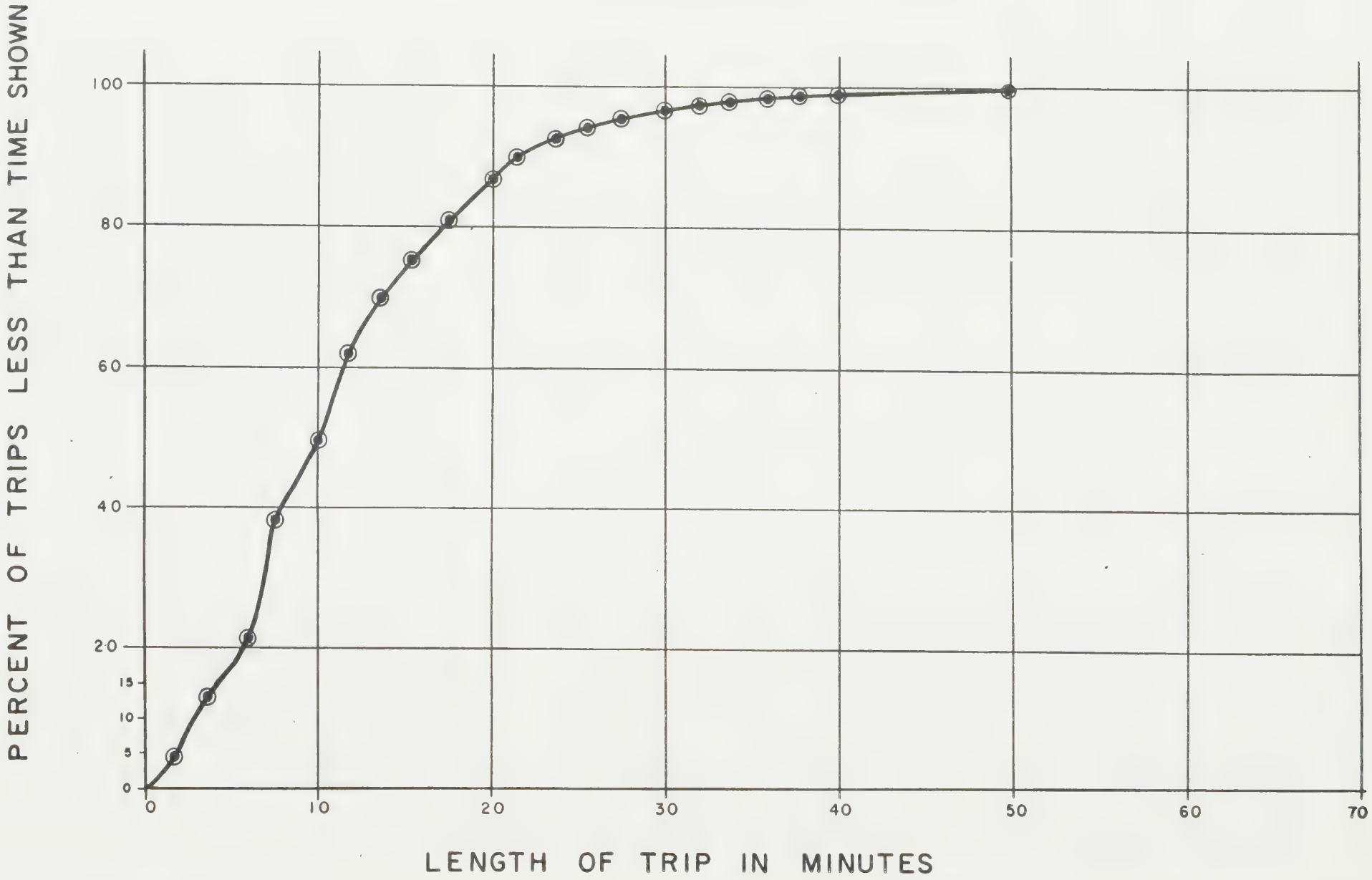
5.9 EXPANSION FACTOR

The modelling of HBO trips in addition to HBW trips in the traffic simulation model will account for only 87 percent of the person travel in the P.M. peak hour. The remaining 13 percent of the P.M. peak hour travel consists of Non Home Based (N.H.B.) trips. It would prove difficult to develop accurate trip generation equations for this trip purpose since the survey data was collected at the home and contains no information on the land use at the origin and destinations of N.H.B. trips. With the small sample size, the information, if factored to zonal totals (as is usually done) and compared to land use, would be of doubtful accuracy.

The N.H.B. travel will be accounted for by factoring up the travel demand simulated for Home Based trips. Total travel demand obtained in this manner introduces some error. Since N.H.B. travel does not necessarily follow the orientation of Home Based travel, there could be an over-estimation of travel in some areas and an under-estimation of travel in others. This error will be no greater than possible errors introduced if the N.H.B. trips were simulated separately from the data

FIGURE 5.11: COMMULATIVE TRIP LENGTH FREQUENCY

HOME BASED OTHER TRIPS



available. The error, if any, will be detected when comparing base year simulations to actual screenline counts.

The H.B. trips simulated will account for 86 percent of the P.M. peak hour person trips and must be increased by a factor of 1.163 to account for 100% of peak hour travel.

## 5.10 DIRECTIONAL SPLIT

It is necessary to have a measure of the directional split of travel demand to fully understand the requirements for transportation facilities. During the P.M. peak hour the majority of travel consists of home based trips with either the trip origin or the trip destination at the residential location of the trip maker. The travel destined to the home end accounts for 82% of all home based travel during the P.M. peak with only 18% originating at the home end. The simulation models require directional split factors to modify trip matrices and simulate the actual direction of travel. For home based trips other than for the purpose of work 61 percent of the travel is destined to the residential location during the peak hour. For home based work, 94% are destined to the residential location.

## 5.11.TRANSIT TRIP CHARACTERISTICS

A separate analysis was conducted on those person trips using the transit mode of travel in an effort to establish the travel characteristics of transit riders and to identify the importance of modal split within the study area. Because of the small sample size of the survey, the summaries related to transit should be considered only general characteristics of

transit travel within the study area and should be used with caution. The information is not adequate for establishing detailed modal split models or for detailed summaries on specific geographic locations and transit lines.

The survey data indicates that 12 percent of all person trips made on an average weekday in the study area use transit. This percentage did not vary significantly for trips occurring in the P.M. peak hour. Table 5.23 shows transit trips by purpose for both the 24 hour period and the P.M. peak hour period. Of the transit trips occurring over the 24 hour period, 91 percent have one end of the trip at the residential location of the trip maker. Work trips and school trips create the major demand for travel by transit over the 24 hour period with work trips accounting for the majority of transit travel in the P.M. peak hour.

Choice transit riders are defined as those trip makers that have a drivers licence and a car available for making a trip but choose to use transit for the trip. Transit riders who do not have a car available and a drivers licence are defined as captive riders. According to the survey findings, only 12.12 percent of all transit trips are made by choice and the remaining 87.88 percent are classified as captive riders.

Analysis of the age distribution of transit riders shows that 16 percent of all transit trips are made by persons under the age of 15 and an additional 15 percent of the transit trip makers are over the age of sixty. This shows that persons in the younger and older age categories are more reliant on the transit service. This is consistent with the fact that

majority of persons in these age categories would be captive riders.

The characteristics of the transit ridership in the Hamilton study area vary with the characteristics in the larger TARMS area because of the level of transit service supplied in the Toronto area. The downtown Toronto area has much better service and a higher percent of transit usage.

Information on the characteristics of the transit ridership from the 1961 HATS study is very limited. The 1961 study showed over 90 percent of transit trips to connect at one end to the trip makers residence and that the majority of transit trips were for the purpose of work. Further comparison proved to be impossible.

TABLE 5.23
TRANSIT RIDERSHIP

| TRIP PURPOSE | 24 HOUR TRIPS | 24 HOUR % OF TOTAL | P.M. PEAK HOUR TRIPS | P.M. PEAK HOUR % OF TOTAL |
|---|---|---|---|---|
| Home based | 926 | 91 | 121 | 88 |
| Home Based Work | 366 | 36 | 81 | 59 |
| H.B. Shopping & Personal Business | 214 | 21 | 19 | 14 |
| H.B. Social, Recreation & Other | 88 | 9 | 8 | 6 |
| H.B. School | 257 | 25 | 13 | 2 |
| Non-Home Based | 98 | 9 | 17 | 12 |

# BIBLIOGRAPHY

1. McCarthy, G.M. Multiple Regression Analysis of Household Trip Generation - A Critique Highway Research Record 297,1969

2. Kannel, E.J., Heathington, K.W. Temporal Stability Of Trip Generation Relations Highway Research Record 472, 1973

3. Toronto Area Regional Model Study - Trip Generation Systems Planning Branch, Ministry of Transportation and Communications of Ontario July 1971

4. Hamilton Area Transportation Plan C.C. Parker & Parsons, Brinckerhoff, Limited May 1963

# APPENDIX A

## O. D. SURVEY

## QUESTIONNAIRE FORMS

## ADMINISTRATIVE RECORD

Interviewer's Name _____

Interview Number _____ ☐☐☐☐

### CONTACTS WITH RESPONDENT

| Telephone Calls | | In Person Calls | |
|---|---|---|---|
| Date | Time | Date | Time |
| 1. | | 1. | |
| 2. | | 2. | |
| 3. | | 3. | |
| 4. | | 4. | |

### REPORT SUBMITTED INCOMPLETE

Date _____ ☐

Reason:
1. Vacant
2. Demolished
3. Comm. Structure
4. Refusal
5. No such address
6. Illness
7. Vacation
8. Out of study area on travel day

Interviewer's Remarks

_____

_____

Supervisor's Remarks

_____

_____

### REPORT SUBMITTED COMPLETE

I certify that the information recorded on this form was obtained from the respondents listed as being interviewed by me at the above address, and that it is true and complete to the best of my knowledge.

_____ DATE

_____ SIGNATURE OF INTERVIEWER

Interview Checked By: Telephone _____ Other _____

Date _____ Initials _____

Coded By: _____ Initials _____ Date

Coding Checked By: _____ Initials _____ Date

## DWELLING UNIT SUMMARY FORM

Interview Name _____

Interview Address _____ Card No. _____ (1) Zone No. _____ (2 3 4)

Interview Phone No. _____ Sample No. _____ (5 6 7 8) Travel Date ___ (9 10 11)

A. 1. Private Autos _____ 2. Company Owned Autos (Include taxis if used for personal use) _____ 3. Trucks (Used only for personal travel) _____ (12 13 14 15)

4. Total Vehicles _____

B. How many permanent residents live at this dwelling unit? _____ (16 17)

C. How many of these permanent residents are 5 years of age or older? _____ (18 19)

D. Total number of trips reported at this dwelling unit: 1. Total Person Trips _____ 2. Total Veh. Driver trips _____ (20 21 22 23)

E. Total number of persons over 5 years of age making trips (Exclude visitors) _____ (24 25)

F. Total number of persons over 5 years of age making no trips (Exclude visitors) _____ (26 27) (28)

G. Household information for persons 5 years of age or older

| Sample | Zone | Person No. | Person Identification | Sex | Age | Drive Auto? | Occupation | Industry | Make Trips | Person Spoken To |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 3 4 5 | 6 7 8 | 9 | 10 11 | 12 | 13 14 | 15 | 16 | 17 | 18 | 19 |
| 2 3 4 5 | 6 7 8 | 9 | 10 11 | 12 | 13 14 | 15 | 16 | 17 | 18 | 19 |
| 2 3 4 5 | 6 7 8 | 9 | 10 11 | 12 | 13 14 | 15 | 16 | 17 | 18 | 19 |
| 2 3 4 5 | 6 7 8 | 9 | 10 11 | 12 | 13 14 | 15 | 16 | 17 | 18 | 19 |
| 2 3 4 5 | 6 7 8 | 9 | 10 11 | 12 | 13 14 | 15 | 16 | 17 | 18 | 19 |
| 2 3 4 5 | 6 7 8 | 9 | 10 11 | 12 | 13 14 | 15 | 16 | 17 | 18 | 19 |
| 2 3 4 5 | 6 7 8 | 9 | 10 11 | 12 | 13 14 | 15 | 16 | 17 | 18 | 19 |
| 2 3 4 5 | 6 7 8 | 9 | 10 11 | 12 | 13 14 | 15 | 16 | 17 | 18 | 19 |
| 2 3 4 5 | 6 7 8 | 9 | 10 11 | 12 | 13 14 | 15 | 16 | 17 | 18 | 19 |

# INTERNAL TRIP REPORT FORM

Card No. [1] Zone [2 3 4] Sample [5 6 7 8] Travel Date [9 10 11]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | 9 | 10 | 11 | 12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Person No. | Trip No. | Sex | Drive Auto? | Where did this trip begin? | Where did this trip end? | Purpose of trip | Time this trip Started | Time this trip Ended | Mode of travel | Car Avail. | No. in Auto | Parking Type | Parking Cost |
| | | M ___ F ___ | Yes ___ No ___ | | | 1 Work 1<br>2 Shopping 2<br>3 Social 3<br>4 Recreation 4<br>5 School 5<br>6 Personal 6<br>7 Chge trvl mode 7<br>8 Serve Pasgr 8<br>9 Other 9<br>0 Home 0 | ___ A.M.<br>___ P.M. | ___ P.M.<br>___ P.M. | 1 Auto Drive<br>2 Auto Passenger<br>3 Commercial Bus or Train Pagr.<br>4 School Buses<br>5 Taxi Passenger<br>6 Truck Driver<br>7 Truck Passenger<br>8 Walk | Yes ___<br>No ___ | | On St.NC ___<br>On Rest. ___<br>On Meter ___<br>Off St. lot ___<br>Struct. ___ | Per H ___<br>D ___<br>W ___<br>M ___ |
| 12 13 | 14 15 | 16 | 17 | 18 19 20 21 22 | 23 24 25 26 27 | 28 29 | 30 31 32 33 | 34 35 36 37 | 38 | 39 | 40 | 41 | 42 43 44 45 46 |

Card No [1] Zone [2 3 4] Sample [5 6 7 8] Travel Date [9 10 11]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | 9 | 10 | 11 | 12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Person No. | Trip No. | Sex | Drive Auto? | Where did this trip begin | Where did this trip end? | Purpose of trip | Time this trip Started | Time this trip Ended | Mode of travel | Car Avail. | No. in Auto | Parking Type | Parking Cost |
| | | M ___ F ___ | Yes ___ No ___ | | | 1 Work 1<br>2 Shopping 2<br>3 Social 3<br>4 Recreation 4<br>5 School 5<br>6 Personal 6<br>7 Chge trvl mode 7<br>8 Serve Pasgr 8<br>9 Other 9<br>0 Home 0 | ___ A.M.<br>___ P.M. | ___ P.M.<br>___ P.M. | 1 Auto Drive<br>2 Auto Passenger<br>3 Commercial Bus or Train Pagr.<br>4 School Buses<br>5 Taxi Passenger<br>6 Truck Driver<br>7 Truck Passenger<br>8 Walk | Yes ___<br>No ___ | | On St. NC ___<br>On Rest. ___<br>On Meter ___<br>Off St. lot ___<br>Struct. ___ | Per H ___<br>D ___<br>W ___<br>M ___ |
| 12 13 | 14 15 | 16 | 17 | 18 19 20 21 22 | 23 24 25 26 27 | 28 29 | 30 31 32 33 | 34 35 36 37 | 38 | 39 | 40 | 41 | 42 43 44 45 46 |

Card No [1] Zone [2 3 4] Sample [5 6 7 8] Travel Date [9 10 11]

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | 9 | 10 | 11 | 12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Person No. | Trip No. | Sex | Drive Auto? | Where did this trip begin? | Where did this trip end? | Purpose of trip | Time this trip Started | Time this trip Ended | Mode of travel | Car Avail. | No. in Auto | Parking Type | Parking Cost |
| | | M ___ F ___ | Yes ___ No ___ | | | 1 Work 1<br>2 Shopping 2<br>3 Social 3<br>4 Recreation 4<br>5 School 5<br>6 Personal 6<br>7 Chge trvl mode 7<br>8 Serve Pasgr 8<br>9 Other 9<br>0 Home 0 | ___ A.M.<br>___ P.M. | ___ P.M.<br>___ P.M. | 1 Auto Drive<br>2 Auto Passenger<br>3 Commercial Bus or Train Pagr.<br>4 School Buses<br>5 Taxi Passenger<br>6 Truck Driver<br>7 Truck Passenger<br>8 Walk | Yes ___<br>No ___ | | On St.NC ___<br>On Rest. ___<br>On Meter ___<br>Off St. lot ___<br>Struct. ___ | Per H ___<br>D ___<br>W ___<br>M ___ |
| 12 13 | 14 15 | 16 | 17 | 18 19 20 21 22 | 23 24 25 26 27 | 28 29 | 30 31 32 33 | 34 35 36 37 | 38 | 39 | 40 | 41 | 42 43 44 45 46 |

# APPENDIX B

## SURVEY NOTIFICATION

THE
REGIONAL MUNICIPALITY
OF
HALTON

OFFICE OF THE CHAIRMAN
ALLAN M. MASSON
3027 HARVESTER ROAD
BURLINGTON, ONTARIO
L7N 3G8
TELEPHONES. MILTON 878 5571
TORONTO 920-6945
BURLINGTON 639-5793

October 29, 1974

Dear Householder:

The Regional Municipality of Halton is cooperating with the Regional Municipality of Hamilton-Wentworth and the Ministry of Transportation and Communications of Ontario in a comprehensive study of transportation needs between the two Regions.

In order to determine these needs, it is necessary to obtain information concerning where, when and how many people travel within and between the two regions. A detailed survey is being conducted including your household, along with several hundred others in the two Regions.

A member of the Transportation Study Staff will contact you on _____ and will ask you questions about trips made by members of your household on the previous day. I trust you will cooperate and give the required information which will be treated confidentially and used only as statistics for planning purposes.

Enclosed with this letter is a TRIP LOG and INSTRUCTION SHEET. If you fill out the TRIP LOG on the day before you are to be contacted in accordance with the directions on the INSTRUCTION SHEET, it will assist in the interview. If you have any important questions concerning the survey, phone 527-9158.

Thank you for your effort on behalf of the community.

Sincerely yours

Allan M. Masson.

Allan M. Masson
Chairman
Regional Municipality
of Halton.

:sj
attach.

THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

OFFICE OF THE CHAIRMAN

*Mailing Address:* 25 MAIN ST. WEST, SUITE 802, HAMILTON, ONTARIO L8P 1H1

BUS. 526-8221 • RES. 527-1476

File No. R-105-G

August, 1974

Dear Householder:

The Regional Municipality of Hamilton-Wentworth, with the co-operation of the Ministry of Transportation and Communications of Ontario, is conducting a comprehensive study of the transportation needs of the Region.

In order to determine these needs, it is necessary to obtain information concerning where, when and how many people travel throughout the Region. A detailed survey is being conducted including your household along with several hundred others in the Hamilton-Wentworth Region and the immediate surrounding areas.

A member of the Transportation Study Staff will contact you on _____ and will ask you questions about trips made by members of your family on the previous day. I trust you will co-operate and give the required information which will be treated confidentially and used only as statistics for planning purposes.

Enclosed with this letter is a TRIP LOG and INSTRUCTION SHEET. If you fill out the TRIP LOG on the day before you are to be contacted in accordance with the directions on the INSTRUCTION SHEET it will assist in the interview. If you have any important questions concerning the survey, phone 527-9150. Thank you for your effort on behalf of the community.

Yours very truly,

Anne Jones

(Mrs.) Anne Jones
Chairman

AJ/lb

Encl.

# INSTRUCTION SHEET

## General Instructions

If you are unable to complete all the information required for the Trip Log then fill out as much as you can.

The Trip Log is to be completed for all Trips made by persons over the age of 5 residing in your household. This includes all members of your family (Husband, Wife, Children, Grandparents, Uncles etc.), all other permanent residents (cooks, housekeepers, boarders etc.), and all overnight visitors who live outside the area covered by the Hamilton-Wentworth Region and Burlington.

The Trip Log is to be completed for all trips made in the 24 hour period beginning at 4 A.M. _____ and ending at 4 A.M. the following day.

Each trip to be recorded is a one-way movement of a person between two points by a single mode of travel.

If a trip maker changes his mode of travel during a trip (for example he drives his car to the bus terminal and takes the bus to work) then each part of the trip by the different modes is to be recorded as a separate trip.

Record no walking trips except walking to or from work.

## Specific Instructions

Ques. 1. Name of Traveller:

Please record the name of each traveller.

Ques. 2 & 3. Trip Beginning or End:

Record the actual street address (for example 795 Main Street West). If this is not possible record the street names of the nearest intersection and the compass direction of the establishment in relation to the intersection. (For example west of James on north side of Main). Names of prominent buildings or stores may be used. (Note: If there is more than one store by that name, i.e. Eatons, in the area, please give the approximate address. The name of the City, Town, or County should be included with every address. The word "Home" is sufficient if the trip begins or ends at your place of residence.

Ques. 4. Time of Start or End:

Record to the nearest minute the time at which the trip starts and ends. Include the time it takes to park your car and walk to the actual destination.

# TRIP LOG

| 1 | 2 | 3 | 4 | |
|---|---|---|---|---|
| NAME OF TRAVELLER | WHERE DID THIS TRIP BEGIN? | WHERE DID THIS TRIP END? | TIME THIS TRIP STARTED | TIME THIS TRIP ENDED |
| | | | A.M. P.M. | A.M. P.M. |
| 1 | 2 | 3 | 4 | |
| NAME OF TRAVELLER | WHERE DID THIS TRIP BEGIN? | WHERE DID THIS TRIP END? | TIME THIS TRIP STARTED | TIME THIS TRIP ENDED |
| | | | A.M. P.M. | A.M. P.M. |
| 1 | 2 | 3 | 4 | |
| NAME OF TRAVELLER | WHERE DID THIS TRIP BEGIN? | WHERE DID THIS TRIP END? | TIME THIS TRIP STARTED | TIME THIS TRIP ENDED |
| | | | A.M. P.M. | A.M. P.M. |
| 1 | 2 | 3 | 4 | |
| NAME OF TRAVELLER | WHERE DID THIS TRIP BEGIN? | WHERE DID THIS TRIP END? | TIME THIS TRIP STARTED | TIME THIS TRIP ENDED |
| | | | A.M. P.M. | A.M. P.M. |
| NAME OF TRAVELLER | WHERE DID THIS TRIP BEGIN? | WHERE DID THIS TRIP END? | TIME THIS TRIP STARTED | TIME THIS TRIP ENDED |
| | | | A.M. P.M. | A.M. P.M. |
| 1 | 2 | 3 | 4 | |
| NAME OF TRAVELLER | WHERE DID THIS TRIP BEGIN? | WHERE DID THIS TRIP END? | TIME THIS TRIP STARTED | TIME THIS TRIP ENDED |
| | | | A.M. P.M. | A.M. P.M. |

# APPENDIX C

## PRESS RELEASE

The Regional Government of Hamilton-Wentworth is in the process of conducting a Transportation Study to determine the present and future needs for improvements of transportation facilities within the Region. Part of the study procedure will be to survey households within and adjacent to the Region to determine where, when and how often people travel.

The survey will cover a number of randomly chosen households throughout the Hamilton-Wentworth Region and the City of Burlington. These households will be notified by mail approximately one week before a representative of the regional study team contacts them by telephone. Persons residing in the sample household will be asked for information about trips made on an average weekday. Information gathered in this survey will be treated confidentially and will be used only in statistical summaries for the planning process.

With the information obtained from this survey the planners will be able to determine the demands for transportation facilities required for new development within the Region, the potential ridership of any new transit systems that will be required and many other factors that are needed to plan good transportation services for residents of the Region. The cooperation of those persons who will be called upon in the survey is necessary to help in planning for better transportation services. By taking the short time needed to answer the questions asked they will be benefiting themselves and all other residents.

Because of the proximity of Halton and Hamilton-Wentworth, the Chairman of Halton has been asked to participate in this survey. The information obtained from the survey will be available to and benefit both regional governments. The Ministry of Transportation and Communications of Ontario is also cooperating in this endeavour and it is felt that the involvement of all three governments will be an excellent step forward in Regional Planning.

# APPENDIX D

## TARMS TRIP GENERATION EQUATIONS

# TRIP PURPOSE 24-HOUR HOME BASED WORK

## TARMS

| Production or Attraction | Range | Independent Variables | | | |
|---|---|---|---|---|---|
| P | Population Per Acre | Population | | | |
| | 0.1 – 10.0 | CX 0.60788 | | | |
| | 10.1 – 20.0 | CX 0.64331 | | | |
| | 20.1 – 30.0 | CX 0.62528 | | | |
| | 30.1 – 40.0 | CX 0.61463 | | | |
| | > 40.0 | CX 0.63421 | | | |
| | | | | | |
| A | Total Employment Per Acre | Retail Employment | Service & Other Employment | Manufacture & Wholesale Employment | |
| | 0.1 – 4.0 | 1.6420 | 2.1430 | 1.7108 | |
| | 4.1 – 10.0 | 1.1428 | 1.6230 | 1.5611 | |
| | 10.1 – 30.0 | 1.5034 | 1.4394 | 1.4927 | |
| | > 30.0 | 1.3801 | 1 6635 | 1.4891 | |
| | | | | | |
| | | | | | |

C = ( TOTAL EMPLOYMENT / TOTAL POPULATION ) HORIZON YEAR

( TOTAL EMPLOYMENT / TOTAL POPULATION ) 1964

# TRIP PURPOSE 24-HOUR HOME BASED

# SHOPPING & PERSONAL BUSINESS

TARMS

| Production or Attraction | Range | Independent Variables | | | |
|---|---|---|---|---|---|
| P | Population Per Acre | Dwelling Unit | | | |
| | 0.1 – 10.0 | 1.6319 | | | |
| | 10.1 – 20.0 | 1.3678 | | | |
| | 20.1 – 30.0 | 1.3493 | | | |
| | 30.1 – 40.0 | 0.76616 | | | |
| | 40.1 – 9999 | 0.66391 | | | |
| | | | | | |
| A | Total Retail Employment | Dwelling Unit | Retail Employment | (Retail+Service +Other) Emp. | |
| | 1 – 100 | 0.21626 | 4.3732 | | |
| | 101 – 300 | 0.079012 | 2.5003 | | |
| | ⟩300 | | | 0.83045 | |
| | | | | | |
| | | | | | |
| | | | | | |

IP PURPOSE 24-HOUR HOME BASED SOCIAL, RECREATION & OTHER

TARMS

| Production or Attraction | Range | Independent Variables | | | |
|---|---|---|---|---|---|
| P | Population Per Acre | Dwelling Unit | | | |
| | 0.1 - 10.0 | 1.0815 | | | |
| | 10.1 - 20.0 | 0.98035 | | | |
| | 20.1 - 30.0 | 0.98981 | | | |
| | 30.1 - 40.0 | 0.68227 | | | |
| | 40.1 - 9999 | 0.63995 | | | |
| | | | | | |
| A | Population Per Acre | Dwelling Unit | Service+other Employment | | |
| | 0.1 - 10.0 | 0.80268 | 0.21985 | | |
| | 10.1 - 20.0 | 0.60743 | 0.32687 | | |
| | 20.1 - 30.0 | 0.57311 | 0.52744 | | |
| | 30.1 - 40.0 | 0.56112 | 0.20087 | | |
| | > 40.0 | 0.35781 | 0.32423 | | |
| | | | | | |

# TRIP PURPOSE 24-HOUR HOME BASED SCHOOL

TARIFS

| Production or Attraction | Range | Independent Variables | | | |
|---|---|---|---|---|---|
| P | Population Per Acre | Population | | | |
| | 0.1 – 10.0 | 0.097188 | | | |
| | 10.1 – 20.0 | 0.108673 | | | |
| | 20.1 – 30.0 | 0.093309 | | | |
| | 30.1 – 40.0 | 0.071167 | | | |
| | > 40.0 | 0.071794 | | | |
| | | | | | |
| A | | Enrollment | Dormitory Capacity | | |
| | High School | 1.0 | | | |
| | University | 1.84 | – 1.84 | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

# TRIP PURPOSE 24-HOUR NON-HOME BASED

TARMS

| Production or Attraction | Range | Independent Variables | | | |
|---|---|---|---|---|---|
| | Total Employment Per Acre | Dwelling Unit | Total Employment | | |
| P | 0.1 – 4.0 | 0.24420 | 0.31527 | | |
| | 4.1 – 10.0 | 0.25599 | 0.17827 | | |
| | 10.1 – 30.0 | 0.34736 | 0.11643 | | |
| | > 30.0 | | 0.22765 | | |
| | | | | | |
| | | | | | |
| A | | | | | |
| | | | | | |
| | | | | SAME | AS ABOVE |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

# TRIP PURPOSE PM PEAK HOUR (4:30-5:30) HOME BASED WORK

TABLES

| Production or Attraction | Range | Independent Variables | | | |
|---|---|---|---|---|---|
| P | Population Per Acre | Population | | | |
| | 0.1 – 10.0 | C X 0.12955 | | | |
| | 10.1 – 20.0 | C X 0.13353 | | | |
| | 20.1 – 30.0 | C X 0.11964 | | | |
| | 30.1 – 40.0 | C X 0.13722 | | | |
| | > 40.0 | C X 0.13509 | | | |
| | | | | | |
| A | Total Employment Per Acre | Manufacture + Wholesale Employment | Retail Employment | Service Employment | Other Employmer |
| | 0.1 – 4.0 | 0.32952 | 0.30929 | 0.30929 | 0.30929 |
| | 4.1 – 10.0 | 0.31838 | 0.30774 | 0.30774 | 0.30774 |
| | 10.1 – 30.0 | 0.30738 | 0.27180 | 0.31446 | 0.31446 |
| | > 30.0 | 0.34331 | 0.21816 | 0.40528 | 0.40528 |
| | | | | | |
| | | | | | |

# TRIP PURPOSE A.M. PEAK PERIOD (7-9) HOME BASED WORK

## TARMS

| Production or Attraction | Range | Independent Variables | | | |
|---|---|---|---|---|---|
| P | Population Per Acre | Population | | | |
| | 0.1 — 10.0 | C X 0.21725 | | | |
| | 10.1 — 20.0 | C X 0.22593 | | | |
| | 20.1 — 30.0 | C X 0.19650 | | | |
| | 30.1 — 40.0 | C X 0.19831 | | | |
| | 40.1 - 9999 | C X 0.19779 | | | |
| | | | | | |
| A | Total Employment Per Acre | Manufacture Wholesale Employment | Retail Employment | Service Employment | Other Employment |
| | 0.1 — 4.0 | 0.53523 | 0.58569 | 0.68839 | 0.68839 |
| | 4.1 — 10.0 | 0.47582 | 0.59574 | 0.46515 | 0.46515 |
| | 10.1 — 30.0 | 0.39876 | 0.61585 | 0.53092 | 0.53092 |
| | 30.1 - 9999 | 0.52770 | 0.55531 | 0.58029 | 0.58029 |
| | | | | | |
| | | | | | |

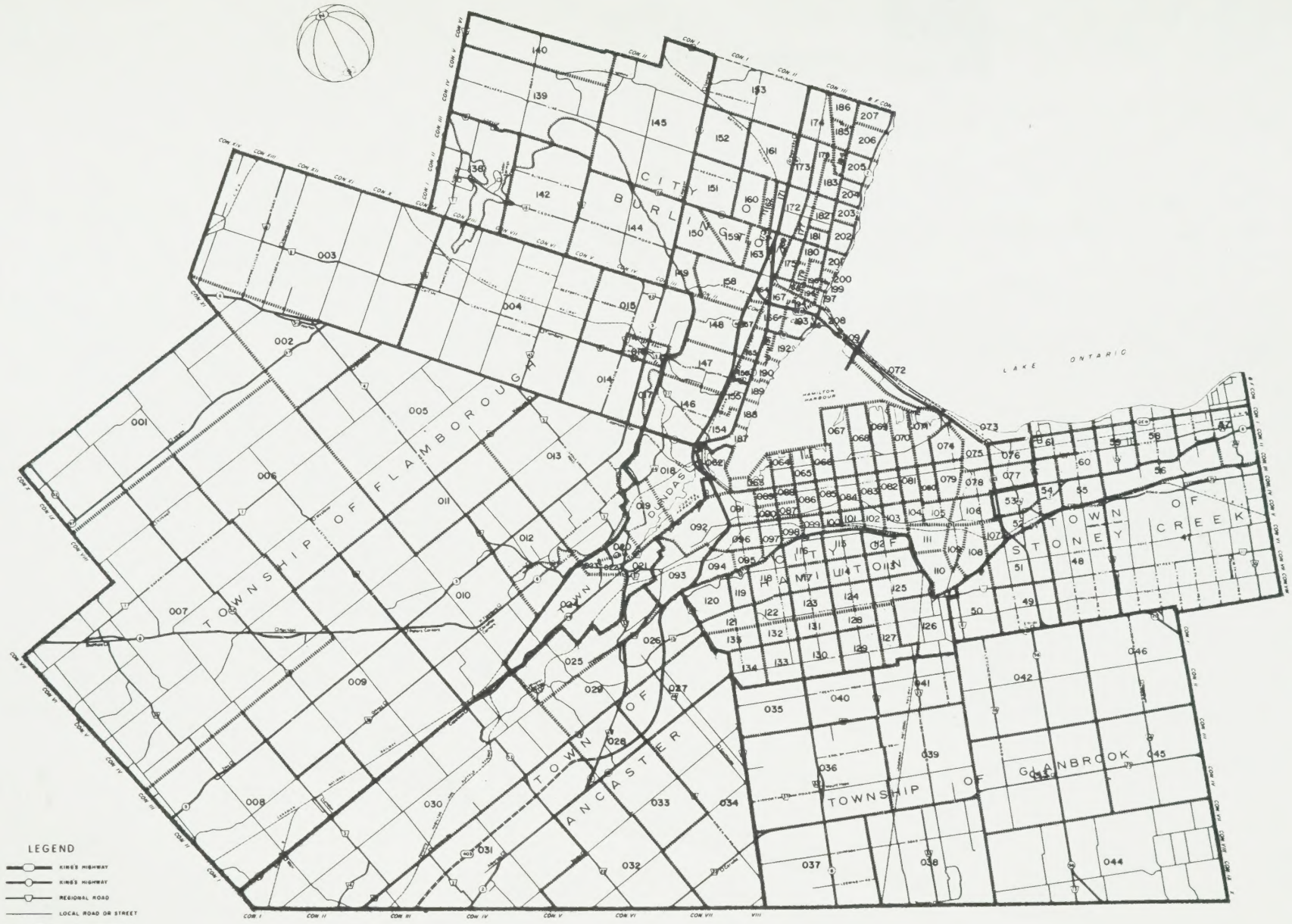
C = ( TOTAL EMPLOYMENT / TOTAL POPULATION) HORIZON YEAR

( TOTAL EMPLOYMENT / TOTAL POPULATION) 1964

# APPENDIX E

## SURVEY TRAFFIC ZONES

# THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
## AND THE CITY OF BURLINGTON




TRAVEL CHARACTERISTIC SURVEY

# TRAFFIC ZONES

PLANNING AND DEVELOPMENT DEPARTMENT
HAMILTON
MARCH, 1973

URBAN/I